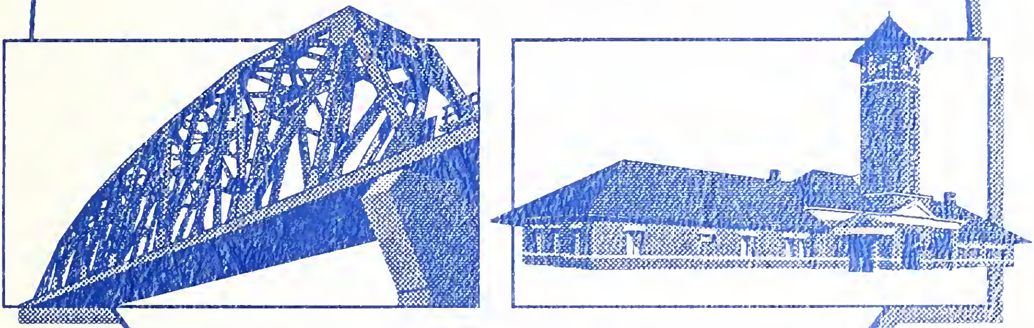
PROCEEDINGS

OF THE

95th ANNUAL CONFERENCE

AMERICAN RAILWAY
BRIDGE & BUILDING
ASSOCIATION



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Proceedings of the

Ninety-Fifth Annual Conference

of the

American Railway
Bridge & Building
Association

Held at

PALMER HOUSE
Chicago, Illinois
September 17-19,1990

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18154 Harwood Avenue, Homewood, IL 60430

William W. Hay

This issue of the Proceedings is dedicated to Professor William W. Hay, our editor for many issues of this publication. Professor Hay earned his B.S. and Management Engineering Degree from Carnegie Institute of Technology and his M.S. and Ph.D. in Civil Engineering from the University of Illinois. He spent 16 years in various engineering positions with several railroads including the Pennsylvania Railroad, Long Island, Milwaukee Road, Reading, Alaska Railroad and the New York Independent Subway System. He served with the Military Railway Service in Europe and served as Chief Engineer of the Korean Railway. Professor Hay also worked as a consultant for several United States and foreign railroads. He is Professor Emeritus of Railway Civil Engineering at the University of Illinois. He joined the Roadmasters and Maintenance of Way Association of America in 1947 and was elected an Honorary member in 1985.

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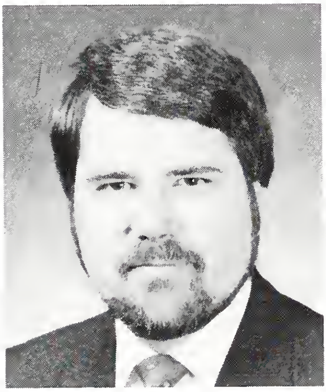

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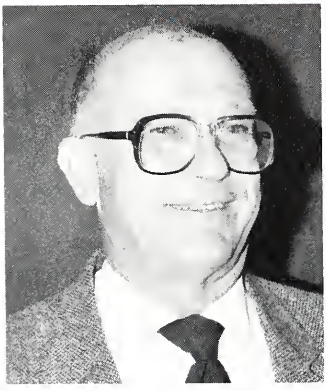

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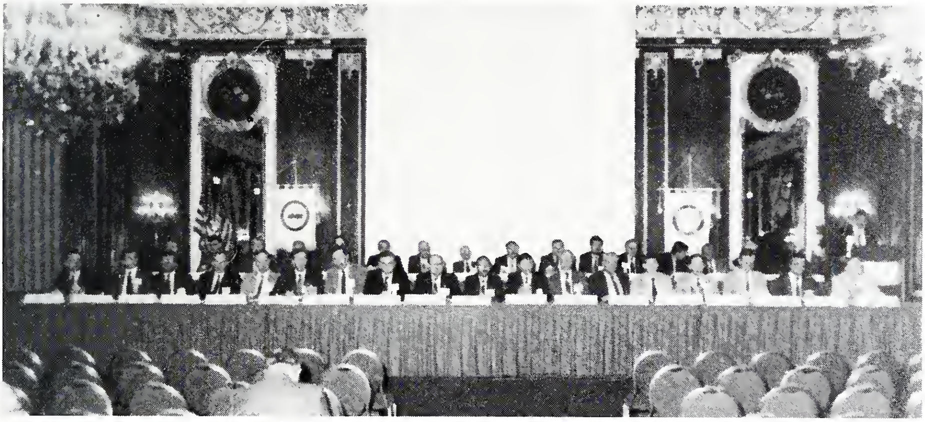
PROCEEDINGS

Monday, September 17, 1990

Opening Joint Session



President Burns: As president of the American Railway Bridge and Building Association and on behalf of Mr. Keith Pottorff, president of the Roadmasters and Maintenance of Way Association of America, I declare this, the 95th annual conference of the American Railway Bridge and Building Association and the 102nd annual conference of the Roadmasters and Maintenance of Way Association of America, to be open and in joint session.

It is proper that we pause and ask for divine guidance and inspiration prior to commencing this conference. I would like to call on Ray Tallent, immediate past president of the B&B Association, to give the invocation. Ray.

Mr. Tallent: Let us pray. Come, Lord, come with us. See with our eyes, hear with our ears, think with our minds, love with our hearts in all situations of our lives. Work with our hands, our strengths, take, cleanse, possess, enhance our will, our understanding, our love. Take us where you will to do what you want in your way. In Jesus' name we pray. Amen.

President Burns: Thank you, Ray. I join with President Pottorff in welcoming all of you to the first joint session of the two Associations at this year's annual conference. As you can see by the program, we have presentations covering many different topics related to railroad engineering and construction.

There will be a bus tour today for the spouses and guests of some of the areas associated with Chicago's prohibition era, followed by lunch at Tommy Gun's Garage and a musical comedy revue. On Tuesday evening at six, REMSA will host the annual cocktail reception. I hope that all of you will plan on attending. At this time I would like to introduce the officers and directors of the American Railway Bridge and Building Association who are seated at the head table. As I introduce each person I ask that he stand and remain standing until all have been introduced. I also ask that you hold your applause until all have been introduced. Beginning on my left, Senior Vice President, John Horney, bridge engineer, Union Pacific Railroad, Omaha, Nebraska; Junior Vice President, Mark Walbrun, project manager-Chicago Union Station, Amtrak, Chicago, Illinois; Junior Vice President, Paul Saletnik, engineer of buildings, Chicago and North Western Transportation Company, Chicago, Illinois; Immediate Past President, Ray Tallent, process engineer track, Norfolk Southern Corporation, Atlanta, Georgia; Treasurer, James Williams, supervisor B&B

(retired), Elgin, Joliet and Eastern Railway, Newaygo, Michigan. Directors: William Nelson, manager maintenance of way training, Burlington Northern Railroad, Overland Park, Kansas; Thomas Parker, project manager, Envirodyne Engineers, Chicago, Illinois; Randy Karsten, B&B utility supervisor, Southern Pacific Transportation Company, Kansas City, Kansas; Robert Carter, general B&B supervisor, Burlington Northern Railroad, Springfield, Missouri; Michael Bradley, project engineer, Conrail, Columbus, Ohio; Doug DeBerg, assistant manager-rail, Atchison, Topeka and Santa Fe Railway, Topeka, Kansas; Donald Sorgenfrei, associate, Modjeski and Masters, New Orleans, Louisiana; Joseph Lileikis, manager structures, Union Pacific Railroad, Omaha, Nebraska; and Thomas Dunn, bridge engineer, Chicago and North Western Transportation Company, Chicago, Illinois. (Applause)

I'll now turn the rostrum over to Mr. Keith Pottorff, president of the Roadmasters and Maintenance of Way Association of America. Keith.

President Pottorff: Good morning. At this time I would like to introduce the officers and directors of the Roadmasters and Maintenance of Way Association of America. As I introduce each one, I ask that they stand and remain standing until all have been introduced. Please hold your applause until the introductions are completed.

First Vice President, Jerome Cossel, chief engineer-design and construction, Conrail, Philadelphia, Pennsylvania; Second Vice President, Stephen Hill, division engineer, Soo Line, Chicago, Illinois; Immediate Past President, E. J. Matte, supervisor maintenance of way-east, CP Rail, Toronto, Ontario. Directors: Ronald Poulsen, director maintenance of way equipment, Union Pacific Railroad, Omaha, Nebraska; Robert Wright, assistant division engineer, Norfolk Southern Corporation, St. Louis, Missouri; D. Keith Nordlund, project manager, Canadian National Railway, Toronto, Ontario; Ray Brosseau, assistant supervisor maintenance of way, CP Rail, Toronto, Ontario; Alan Butler, system engineer public improvements, Conrail, Philadelphia, Pennsylvania; Carl Edwards, assistant division engineer, CSX Transportation, Nashville, Tennessee; Johnny Johnson, manager maintenance of way training, Atchison, Topeka and Santa Fe Railway, Albuquerque, New Mexico; Kendall Koff, project engineer, Southern Pacific Transportation Company, Springfield, Illinois; Barry Mohl, superintendent maintenance of way, Birmingham Southern Railroad, Birmingham, Alabama; Herb Clark, director maintenance planning, Chicago and North Western Transportation Company, Chicago, Illinois; James Young, general manager maintenance of way and engineering, Southern Pacific Transportation Company, San Francisco, California; Eugene Schubel, division engineer, Burlington Northern Railroad, Springfield, Missouri. (Applause)

At this time I would like to introduce Mr. Donald E. Turney, Jr., president of the American Railway Engineering Association and chief engineer line maintenance for the Norfolk Southern Corporation. Don.

Greetings from AREA

Mr. Turney: Good morning, President Burns, President Pottorff, ladies and gentlemen. It is with a great deal of pleasure that I extend greetings from AREA to the American Railway Bridge and Building Association and the Roadmasters and Maintenance of Way Association of America. We wish both Roadmasters and Bridge and Building a very successful and productive 102nd and 95th annual conference, respectively. I think it is interesting to note that AREA is a fledging in this type of activity as we are only in our 91st year.

Our three professional organizations have enjoyed a long and productive relationship and have been very supportive of each other in the past. I am confident that we will continue to have a close working relationship that will benefit all three organizations and the industry in the future.

These are challenging times in our industry. Our business is very competitive within the rail industry itself, but as we all know, the real competition is in the trucking industry and the real danger that lies ahead is the potential of the longer combination vehicles in the trucking industry. Our ability to remain competitive requires the ingenuity of all of us in the maintenance of way department to provide track, roadbed and structures that are capable of handling our business at the lowest possible cost. As annual track and structures cost play a major role in the bottom line of our company, our organizations, AREA, Roadmasters, B&B, and REMSA, have had a good track record of accomplishments in the past in matters of increasing productivity. Through continued research, application of new technology, innovations in maintenance of way practices and procedures, and sharing our knowledge with each other I think we can meet the challenges that face us in the maintenance of way department in the future.

I have two plugs here for the AREA that I would like to mention at this time. One, of course, is the upcoming AREA regional conference to be held October 25 in Jacksonville, Florida, for those of you who might be able to attend that conference. I'm sure it will be most interesting. Also, there is a train trip from Jacksonville to Miami on CSX trackage that will be available on the following day, October 26. There is still plenty of space available.

The second thing I would like to remind everyone of is the AREA's annual technical conference to be held here in this hotel on March 18, 19, and 20, 1991. To be featured in the 1991 conference will be the second REMSA mini-expo that was introduced a few years back and proved very successful.

Again, best wishes to Roadmasters and the B&B on a most successful conference. Thank you. (Applause)

President Pottorff: Thank you, Mr. Turney. Now we would like to introduce Mr. Jon Schumaker, president of Pandrol, Incorporated, and president of Railway Engineering Maintenance Suppliers Association. Mr. Schumaker.

Greetings from REMSA

Mr. Schumaker: Good morning. President Burns, President Pottorff, special guests, ladies and gentlemen. As president of REMSA I am honored to have been asked to join in welcoming the annual conference of Bridge and Building and the annual conference of Roadmasters. I know that all members join me in this and we wish you a most productive conference over the next few days. We also hope that your stay will be a pleasant one and if the officers and directors of REMSA can be of assistance in any way please let us know.

REMSA very much appreciates the opportunity to participate in your conference and we hope that the REMSA-sponsored activities, such as the breakfast bar and the Tuesday night reception, help all attendees, railroad members and suppliers alike, to benefit from these opportunities to informally get together, trade ideas, discuss problems and hopefully even find a solution or two.

I wanted to take just a couple of extra minutes this morning to discuss railroads and REMSA. There have been a lot of changes in this industry over the years and one of the most noticeable is the cooperation between railroad and supplier. The realization that more can be done through cooperation than by going off on separate avenues is here. The big shows such as was held last year in Toronto, and in 1985 in Dallas, provide perhaps the largest example of mutual benefits resulting from the excellent cooperation REMSA has enjoyed with your associations. We feel that the meeting and the educational opportunities such events offer provide benefits for years afterwards. The next large show is scheduled for September, 1993, in Denver's brand new downtown convention center. Between now and then REMSA will sponsor a mini-expo here in Chicago at this hotel in conjunction with the March, 1991, AREA annual technical conference.

As I'm sure you all know, REMSA enjoys the same close mutually beneficial relationship with the AREA as it does with your two fine organizations. REMSA also works closely with the RPI and their efforts to help get just consideration from our legislators in Washington on matters pertinent to the railroads and the railroad supply industry. REMSA and several other railroad supply industry associations recently made sizable cash contributions to these efforts and currently we are working with the RPI and others in direct mail efforts and additional means to fight the trucking industry's efforts to gain increased legalization of the longer combination vehicles when the highway trust fund authorization expires in 1991. This is a very important issue for all of us.

We want to continue this sort of cooperation and to do that we need your input. Tell us your problems, not just specific ones for a product line but also industry problems such as this threat from the truckers. As you can tell from our letterhead we have a fine group of officers and directors at REMSA and together we can make a difference. Thank you for letting me go into this. We felt the various objectives in REMSA needed to be explained.

To return to the global matters, I want to invite all of you and your spouses to the annual reception tomorrow evening in the Grand Ballroom at six o'clock. Complimentary tickets are available for registered railroad personnel and their spouses and are available at the REMSA ticket table in the registration area both today and tomorrow. Suppliers, as usual, may purchase their tickets at the same table. With that I'll close. I'm sure you have a lot to do here. Thank you. (Applause)

President Burns: Thank you, Mr. Schumaker. At this time I am pleased to introduce Mr. Michael R. Haverty, president and chief operating officer of the Atchison, Topeka and Santa Fe Railway Company. A native of Atchison, Kansas, Mr. Haverty began his railroad career in train service with the Missouri Pacific Railroad in 1963. Following graduation from the University of Southwestern Louisiana, he completed Missouri Pacific's management training program and held various operating positions with them before joining Santa Fe in 1970.

With Santa Fe he has worked as trainmaster at San Bernardino, California; assistant superintendent at Richmond, California, superintendent at Emporia, Kansas; superintendent at Temple, Texas; assistant vice president operations at Chicago and then vice president operations before being promoted to his present position June 1, 1989.

Mr. Haverty holds a masters degree in business administration from the University of Chicago, presently serves on the Executive Committee of the General Manager's Association of Chicago, the Board of Trustees of the John W. Barriger III National Railroad Library, and was past chairman of the Transportation Research Board's committee on railroad operations management. He also is a member of the Association of American Railroads Board of Directors.

Mr. Haverty and his wife, Marlys, reside in Naperville, Illinois, with their two sons, Michael and Ryan and daughter Shannon. May I now present Mr. Michael Haverty.

KEYNOTE ADDRESS

Michael R. Haverty

President and Chief Operating Officer
Atchison, Topeka and Santa Fe Railway Company

Michael R. Haverty

Thank you very much, Byron, it is certainly a pleasure to be here. I am sure that all speakers say they are glad to be at an event like this but I feel like I have a pretty close tie to railroad maintenance. My great-grandfather came over from Ireland 125 years ago and settled in Atchison, Kansas, starting as a B&B helper and eventually working up to foreman. I worked on a section gang in Atchison in my youth. I had an old uncle who worked for Missouri Pacific for over 50 years and he gave me sound advice when I started out. He said, "Remember, you are working for a railroad. If you do not maintain that road, you cannot stay in business." These are words I never forgot and still am guided by them today.

I doubt that I have to convince anyone in this room of the importance of maintenance. But let me cite a few facts, anyway.

To tell this story properly we have to go back to 1887 when railroads were first regulated. There is no question that railroads were then the predominant mode of land transportation in the country. As the decades passed, though, that predominance changed, but the regulation didn't. Billions of federal dollars built interstate highways and waterways, both of which whittled the railroads' share of freight traffic. Meanwhile, we were still being treated as a monopoly of sorts.

The result was inevitable. In the 1970's more than 20 percent of the American railroad systems was in bankruptcy. There were nearly 50,000 miles of track under "slow orders". That happened because outmoded regulations kept the industry from making a decent rate of return—it dipped at one point to 1.2 percent—and the industry as a whole couldn't afford the plant and equipment renewal that was needed. You all know the story about the one "standing derailment" that made the industry a laughing stock.

I am going to skip over a lot of history now and go right to the Staggers Act of 1980 when we were freed of a great deal of regulation. What have we accomplished since then? Between 1980 and 1988 railroads invested more than $20 billion to renew track, roadbed, signals and structures. Many more billions were invested in new cars and locomotives. And what has been the result? Between 1980 and 1988 the number of train accidents dropped by 64 percent; accidents attributed to track defects fell by 73 percent; accidents attributed to equipment failure fell by 65 percent; accidents attributed to human factors fell by 56 percent; the number of train accidents in which there was a release of hazardous chemicals dropped by 63 percent.

That is what deregulation did for us on the operating side. And our ability to operate safely and efficiently led the way to new marketing ventures.

Ask yourself whether, without good track and roadbed, we would have new double stack container trains being introduced almost weekly. Ask yourself whether these trains would be running at near passenger train speeds.

Ask yourself whether we would be able to provide "just-in-time" service to automobile manufacturers and other shippers. Ask yourself if we could have handled some of the large grain shipments in recent years almost without a hitch. Ask yourself if we could have eliminated numerous train-crew change points because of our ability to operate faster trains.

And, after you have thought about those things, ask yourself where the industry would be today if we hadn't been able to achieve those accomplishments. I will tell you where we would be—we would either be bankrupt or we would be nationalized. And we could have accomplished none of those things—nor many others—without good track and roadbed.

So, where is the industry today? Our tracks and roadbeds are in the best condition in modern history. Our capacity is so under-utilized that it has been estimated that four times as much freight could be handled without adding another mile of track. We have the capacity to divert massive volumes of freight from highways, thereby reducing air pollution, energy consumption and pressure on the highway infrastructure.

That couldn't come at a better time. You can hardly pick up a newspaper or magazine today without reading some story about over-crowded highways or crumbling bridges. Editorial writers and columnists are having a field day writing that government has to "do something." How many of them, though, recognize and write that railroads are part of the answer to this problem? Unfortunately, not many.

What is the problem here, anyway? Why doesn't the public recognize us for what we are and what we can do? I am sure I don't know all the answers. But I do have some thoughts on the subject.

Turning to my own railroad as an example, the papers are filled these days with two kinds of stories. One deals with reductions in employment, and the other deals with sale or abandonment of branch lines. The man in the street reads those stories and draws the conclusion that railroads are on hard times and that we are retrenching. From there it's a logical step to assume that the industry can't accommodate a larger amount of traffic. Research done by the AAR confirms that people still generally like railroads, but they doubt our ability.

Let us consider employment and downsizing a little bit, though, and see if they are really indicative of the industry's capability. When I started with the Santa Fe just over 20 years ago we had more than 35,000 employees. Today we have just a little over 16,000. In 1970, though, we handled just over 47 million ton miles. Last year we handled over 72 million ton miles. That pretty much puts to rest the idea that employment levels reflect business levels. In fact the two have been going in opposite directions.

The same is true of mileage. In 1970 we had over 12,500—today it is a little over 10,000, and in the not-too-distant future we expect to be down to around 7,000. Those 7,000 miles, however, account for over 95 percent of our revenues and virtually all of our profit. We hope to sell most of the excess trackage to short line operators. This streamlined track configuration will allow us to concentrate our maintenance dollars on our core route, and that is just what we intend to do. Our core route is in as fine a shape today as it has ever been, and we intend to keep it that way.

That great Chicago Bear football player, Walter Payton, when discussing the fall of the Bears from Super Bowl champions a few years ago to also-rans last year was quoted as saying: "Tomorrow is not promised to anyone". That is as true of railroads as it is of football teams. While you and I can't control the state of the economy, and we can't decide when there is going to be a grain export program or an increase in auto sales, we can, and do, have a big say in the physical state of our railroads. It's up to us, then, to make sure they don't deteriorate physically. Because when that demand for additional service comes—and I, for one, am confident that it will — when that "tomorrow" comes, our physical plant had better be up to the task.

At the Santa Fe we're looking for growth in a lot of areas, everything from automobiles to garbage. We are working hard to get it. But, all things considered, it seems obvious to us that the biggest growth is going to come off the highways in our intermodal service. The only way we can get that business, though, is by being competitive service-wise. We cannot be competitive running at top speeds of 40 miles per hour or through a bunch of slow orders.

As I said, earlier, one of our problems is convincing people that we are up to the task. I found that out when I made some sales calls on non-rail users when we introduced the Quantum service with our partner, J. B. Hunt. Those traffic managers just did not want to believe that we could be competitive with truck service over the road between Chicago and Los Angeles. Some gave us a couple of loads out of the kindness of their hearts, I guess, and then were shocked when we not only met truck service, but beat it! Those people are believers now.

I have found that one good way to make believers out of non-believers is to take them out for a ride on the railroad. We try to get them on the end of a trainload of articulated flat cars, and they just can't believe their eyes when they see how smoothly those trailers or containers are riding. Part of that is the articulated equipment, of course, but again, a large part is the track and roadbed.

What else can we do to spread the word that railroads are modern, progressive and service sensitive? How can we convince people that reducing employment is a sign of our efficiency, not a sign of our downfall? What can we do to make people understand that selling branch lines to short line operators is a way to improve rail service, not eliminate it?

It's easy to say we should advertise more and, sure, advertising can play a role. I think there is some good railroad advertising being published. But I think each one of us can help beat the drum a little by taking every opportunity that comes our way to tell our story. People are much quicker to believe what they hear from their friends and neighbors than what they read in the newspapers.

In the long run, though, the best way to change this negative perception about railroads is through our actions. I am an eternal optimist, and I firmly believe that expensive energy costs and worn out highways are going to lead people to give us a chance to perform. And that's where you come in, again. ''Nothing succeeds like success'' is an old saying, but it is still true. People may give us a try out of a sense of necessity. If we are ready for them, and if we perform, they are likely to stay with us out of a sense of satisfaction. And, if we are successful in keeping our facilities in top shape, the battle will be half won.

When I think about advancements in the railroad industry, I inevitably think of computers, and centralized dispatching, E.D.I., improved locomotives and cars and other things. But I keep coming back to the really great strides you have made in the last couple of decades in mechanizing our maintenance. I don't know where we would be if that progress hadn't been made, but I do know we would be a lot worse off.

I am not suggesting, though, that it is time for you to sit back, prop your feet up on the desk and relax, because there is more that needs to be done. Here are just a few things I suggest you devote your efforts to: First, we need to re-evaluate our maintenance of way functions in line with the changes in our industry. There is no question that the rail and supply industries have done a remarkable job over the last two or three decades in mechanizing what was once a very labor-intensive activity. But changes in our traffic mix, time-sensitive transportation contracts, and the continued rationalization of rail networks have caused a growing concentration of performance-related traffic on our core routes. This has conflicted directly with the availability of track time windows to perform maintenance work. That, in turn, has had an adverse impact on efforts to maximize the production potential of large, heavily-mechanized gangs.

The challenge for you today, then is to develop alternative methods and procedures which focus on mechanization geared to minimal disruption of track availability for trains. To add to that challenge, it is important that you find a way to do that without jeopardizing the economies you worked so hard to obtain through mechanization.

My second challenge to you is to instill in your people enthusiasm and high standards of work quality—doing the job right the first time. We cannot afford workmanship which shortens the life of our infrastructure or does not maximize the design life of components. In that connection, it is important that research efforts continue into new or strengthened materials with longer lines.

One important benefit of meetings like this is that it allows you to share your ideas and communicate with one another. You people in this room know more about the industry's day-to-day maintenance challenges than anyone. Collectively you can lead the way to finding better ways to prolong the strength and life of our track and bridge structures. I believe that it is most important that you don't accept anything simply because "it's always been done that way". That kind of thinking has to go.

As we continue with the development of total quality concepts within the rail industry, we also must have quality assurance programs in the supply industry. Those suppliers who are successful in their quality efforts will inevitably have a competitive edge. I look forward to a continuing partnership between the rail and supply industries. With renewed threats from the trucking industry, it is vital that we work harmoniously to improve our efficiency and competitiveness.

My third suggestion has to do with the application of technology. Historically we have looked at the available capital dollars and then prioritized maintenance programs based on personal knowledge, experience and talents, and that was good. Today, though, you have available computer-assisted planning tools such as geometry car analyses, historical trends of rail and tie failures, and scheduling programs. It is important that we apply that technology fully, so that we can assure maximum benefits from our available resources.

I devoted the first part of these remarks to outlining the key role I believe you played in the railroad industry's recent success. I will close my remarks by saying that your success in responding to today's challenges will be equally important to our future success. You have an excellent agenda ahead of you for this meeting, which makes clear to me that you are planning for tomorrow. I wish you success with it. Thank you very much. (Applause)

President Burns: Thank you, Mr. Haverty. At this time I will turn the program over to Mark Walbrun who will introduce our first special feature speaker. Mark.

Mr. Walbrun: Our first speaker today is Dan Worth, an associate with BV&H, which is an architectural firm that specializes in renovation of structures and facilities. Over 50 percent of BV&H's work is involved in the preservation of existing buildings. They work very closely with the Smithsonian on their projects. The presentation today is about the Union Pacific's renovation of their freight house which they later turned into the Harriman Dispatch Center. As you know this has received a lot of trade press but primarily focusing on the center as a signal facility not as a renovation of the building which is the outline of today's presentation. So we hope you'll see it from a different light.

Dan Worth received his BSA from the University of Nebraska in architecture. He studied at the Architecture Association in London and he has been with BV&H since in 1981. Dan.

UNION PACIFIC HARRIMAN DISPATCH CENTER

Dan Worth

Associate
Bahr Vermeer & Haecker Architects

Good morning. I am excited and privileged to be with you in Chicago today. My presentation is about Union Pacific's recently completed Harriman Dispatching Center and the rehabilitation and renovation and construction process that was used in creating the dispatch center.

Project Background

Late in the fall of 1987, a bold step was taken by the Union Pacific Railroad. They saw the need to create a state-of-the-art train dispatching and crew management facility at one central location. Consolidation would create the world's largest and most sophisticated electronic rail dispatching center. By consolidating and streamlining the UP dispatching system, great efficiency in consumer service and train operation could be realized while saving close to $1 million per month in operating costs.

A team of architects and engineers was assembled to investigate the options for the dispatching center. Omaha was chosen as the site for the Center due to its central location and because it is the site of Union Pacific's headquarters. The team was composed of Bahr Vermeer & Haecker Architects, Leo A. Daly Company, Thompson Dreessen & Dorner, and Bruce Frasier. Bahr Vermeer and Haecker was responsible for historic preservation of the head house and freight house, program and space planning, interior architecture and landscape architecture.

The Leo A. Daly Company was responsible for the computer center or the "bunker" as we call it, the dispatching facility architecture and engineering and the electrical, mechanical and civil engineering for the entire project.

Thompson Dreessen & Dorner was responsible for structural engineering related to historic preservation, and Bruce Frasier was the owner's design representative and liaison to the UP chairman.

The team investigated options for new construction but quickly focused on reusing this vacant freight building in Omaha's warehouse district. This area was undergoing a major re-development including the construction of a new headquarters complex for ConAgra, Inc.

The Union Pacific freight house was owned by UP and was vacant since 1977 and contained approximately 49,000 gross square feet of space. Its long rectangular configuration on one story seemed to match the program criteria for the dispatch center.

This 1890 building may not outwardly appear to be historically significant. This view was taken in 1932. But on the steps of this building on November 1, 1897, a group of investors led by Edward H. Harriman purchased the bankrupt railroad government mortgage for $58,000,000. This building was the site of the beginning of the modern UP system.

The freight house served the UP as a distribution facility for freight and goods being shipped to new western settlements. This slide shows the large main space in which rail freight cars were unloaded and the freight was loaded onto trucks. Note the great clear span space and the wonderful iron truss members.

Process Building Investigation

At the beginning of the renovation process, the team prepared a feasibility study for the reuse of the freight house building. The study involved a design analysis to see if the required space for the dispatch center could fit or could be accommodated within the existing building. Structural, mechanical and electrical engineering analyses of the building were also undertaken. A historical assessment and physical condition evaluation of the building was also done and, of course, the study included project cost estimates.

The next series of slides gives you a brief idea of the building condition as it was found on December 1987. The building was abandoned for approximately ten years. Masonry was deteriorated and limestone was spalling. Windows were deteriorated and roofing and downspout failures were quite common, exacerbating further deterioration.

Inspection of the interior also revealed many poor conditions. The interior had received many additions and alterations over the years but still the great vast space was intact. This volume was an important aspect of the design solution as we will show in a few moments. Also, during the feasibility study stage, original plans of the freight house were found in the Union Pacific drawing archives. These proved to be invaluable in helping us to understand the historic building technologies of the period. This slide shows the main level plan, basic configuration of the head house, freight house and south elevation showing freight doors, docks, clearstory lighting. This drawing shows details of the head house and main west building facade. Note the ornate sheet metal cornice and vault details.

This drawing gives a good understanding of the basic building systems used in the construction of the freight house, iron trusses, brick bearing walls, on stepped footings with stone foundations. This building section delineates the head house structural system as being of simple wood framing. Additional details in the drawing set included original window and door details and details for overhead freight doors.

This space summary shows that approximately 47,500 square feet of space was contained in the existing building, while approximately 79,000 square feet of space was needed for new dispatching functions. As you will see in the next series of slides, the vast interior space of the main freight house area allowed us an opportunity to create additional levels needed for the space requirements for the new dispatching center.

As we designed the new facility, the design team took great care in maintaining the integrity of the historic elements while integrating new technologies and functions into the existing building. The following slides will show you the design team's solution of integrating this new use in the existing building. This drawing is of the dispatch center's site plan showing the final configuration of the dispatching complex. Please note the position of the freight house, head house, computer center, main entry and entry plaza. Adjacent to the north and east of the site are new facilities for ConAgra.

This is a drawing of the main level floor plan. If you remember the original plant, this area was open, allowing trains to come in the building. Inserted in this space is a new building within the building. This is the heart of the dispatch center and is commonly called the "bunker". Within the bunker, at the main level, is where the dispatchers and the crew management work. Also note the main entry and security station and entry plaza. The new building to the south is the computer center and contains all mechanical and electrical equipment, computers, switching equipment and emergency stand-by generators. The head house area contains management personnel and conference spaces.

This is the upper level floor plan. As mentioned earlier, we created additional space by inserting an upper level in the main freight house space. This upper level is actually on top of the one story bunker structure inserted on the first level of this space. On top of the bunker are open offices for time keeping and payroll personnel. Located within the head house are more management offices, and a new board room/conference room was located on the third floor of the head house. The second level of the computer facility contains switching and computer equipment.

This is a cross-section drawing of the dispatching facility. The original building foundations were undisturbed as the new bunker structure was placed on piling and was not connected to the original. The new computer facility at the south is connected to the other buildings by a utility tunnel which supplies the spaces with power, communication and heating and cooling. I might add at this point that the bunker structure and the computer center were designed to withstand tornado force natural disasters. The whole facility was designed so that the existing structures could be literally blown away leaving the bunker and the computer center operating self-sufficiently for approximately 30 days with no external electrical or water supply.

This sketch shows the interior concept of the freight house area on top of the bunker. This is the open office area for the payroll and time keeper functions. Also note that the trusses have been left exposed, revealing and keeping the true architectural space and essence of the building.

This drawing is of the west elevation in its restored condition. The original cornice and parapets have been replaced. The computer facility is to the south. Its design relates to the original building configuration.

At the end of the feasibility study, Union Pacific was certain that the design in this building would work perfectly for the dispatching center. The project was within their cost budget limitations and they asked us to proceed. They also asked that the dispatch center be able to dispatch the first train by April 15, 1989, or in about one year's time. Since we were able to re-use the existing building a substantial amount of new construction was deferred and allowed us to meet this time schedule. Within the next four months we produced about 250 sheets of contract drawings and about a 1,000 page specification. This allowed approximately eight months remaining for construction. To help expedite the construction, we split the work into two packages—a demolition and site preparation package and a general construction package.

The demolition and site preparation began in May 1988. Work included removal of all track around and within the building and removal of the cobblestone paving around the building. The cobbles were stockpiled, cleaned and re-used as you will see later.

Underground fuel tanks around the site were removed and asbestos abatement within the building was completed.

Removal of all existing mechanical and electrical systems in the interior of the building was completed in this pre-construction phase.

Within the head house all floor framing systems were totally removed as the existing structure was rotten due to roof leaks and was also undersized for the new office loads.

The east loading docks were demolished. A portion of the east wall was then removed because of structural deterioration. This allowed for conversion to the new east entry. All of the brick from the east facade was saved, cleaned and re-used to repair deteriorated brick elsewhere around the building. Interior grading within the freight house area was also completed in preparation for the new construction.

A contract was awarded to Peter Kiewit Construction Company in July, 1988. Piling and foundation work started soon thereafter. Approximately 800 of 30 to 40 foot steel piles were driven at the interior of the freight house. It was a bit tricky to drive piling in the freight house, but pre-drilling and splicing of the piles helped to accommodate the limited height in the space.

This view shows the freight house after the piling had been completed and as the pile caps and foundations are proceeding.

This view shows foundations and bunker walls inside the freight house as they start to emerge within the space. Due to the need for the dispatch center to resist natural disasters, reinforced concrete was chosen for the construction of the dispatch bunker and computer center.

Due to the compressed construction schedule, extra work shifts for forming and reinforcing were started and continued until the bunker construction was completed. Simultaneously, piling foundations and structure for the computer center were being constructed. Note the heavy reinforcement of the computer center wall construction.

The president of Union Pacific was involved extensively in the project process and would occasionally examine the progress of the project. We would discuss schedules and resolve design details with him quite often on site. While all of this was happening on the inside of the freight house, work on the exterior was proceeding in an effort to beat the onset of winter.

The brick exterior walls received 100 percent tuckpointing. Deteriorated areas were rebuilt and repaired utilizing brick from the east end of the freight house. The entire brick facade was cleaned using chemical strippers. At some point in the past all of the brick on the building was painted, so stripping removed this paint. The masonry was then cleaned and thoroughly rinsed.

The limestone foundation was totally excavated and the building foundation was allowed to dry out. This limestone foundation had absorbed a great amount of moisture causing excessive surface deterioration. A waterproof membrane foundation drainage system was installed to prevent further water penetration into the wall system.

Masonry work at the foundation continued through the winter and required temporary protection and heat. Underneath this tent, limestone sills, limestone water table and the entire limestone veneer above grade was being replaced. This repair work occurred around the entire building.

The roof of the freight house required extensive work. This view shows an area where the original clearstory was infilled with steel roofing. The steel roofing was removed and wood decking was reinstalled in this area and in other deteriorated areas. On top of the original wood roof deck, four-by-four wood blocking was lagged to the deck. Four inches of rigid insulation was installed and new plywood sheathing was installed on top of the four-by-fours to create a solid roof diaphragm.

A 20 ounce copper standing seam metal roof system was chosen for the freight house and computer facility. This provided a lifetime roof system for the dispatching center. In this view, continuous pan sections are being site formed. Copper pans were then stockpiled until weather and wind conditions allowed construction to occur. Most of the roof was applied during December through February. Pan sections were then hoisted to the roof and staged in groupings to allow smooth installation. This aerial view shows the copper roof material fully staged. Installation of the standing seam roof was starting from east to west. Also, the tornado proof concrete structure for the computer center is nearing completion.

As the roof was being completed over the head house area, the parapets were reconstructed and elevator and smoke hatches were installed. All low sloped areas, valleys and roof edges received additional EPDM membrane flashings.

This view is taken looking up at the west head house facade. Note that the new window sash have been installed as well as new limestone window sills. The roof edge has been readied for final cornice installation.

This view is of the cornice at the head house after installation. The roofing is complete at this point. The cornice was shop built of galvanized steel. The design was recreated from the original details found in the drawings that were shown earlier.

This view, looking down between the freight house and the computer center in early March, 1989, shows the building totally enclosed. Windows are installed, limestone repair is complete, and the roof drainage systems are connected.

Back at the interior of the freight house, this view is in December, 1987. Forming and pouring of the bunker was continuing at a very rapid rate. Pours of 400 to 800 cubic yards a day were not uncommon.

At the head house a totally new steel floor structure was installed. As mentioned earlier, the existing wood structure was totally deteriorated and unsafe. It was completely removed and a steel structure inserted. Four inches of concrete were later installed on top of the steel deck. Two new steel pan stairs were installed in the head house to provide access to all levels and for egress requirements.

As the bunker concrete construction was being completed inside the freight house area, staging began on top of the bunker for final repair to the wood decking and for mechanical duct, sprinkler system and lighting installation. The repaired wood roof deck and cleaned iron trusses were then primed and painted.

As a final precaution and protection to the delicate electronics in the bunker area, an elastomeric waterproofing was applied on top of the bunker to act as a roof in case of a natural disaster and failure of the freight house envelope. At the interior of the bunker, final finishing had begun. Rear projection screens and projector racks were being installed and the dispatching screens were being assembled.

This aerial view was taken in early March 1988 approximately seven months after construction had begun. The computer center is finished and the equipment is being installed. The east glass curtain wall and the construction of the entry plaza has begun.

This is a view of the completed computer center. Limestone and brick details recall the details on the original building which help blend the new structure with the historic structure. This building is without windows because, as mentioned earlier, it is hardened to take tornado forces. Inside the computer center, final connections and equipment testing were continuing. Switching and relays were being connected and dispatching programmers were beginning to fire up the computer system.

The computer center contains three dual sets of VAX 8530 computers. Each pair of computers is identical yet independent. They operate in a hot standby mode with automatic switching in the event of a failure by any on-line computer. The computer center also houses an 800 KVA uninterruptable power source capable of supplying 30 minutes of power to the computing systems and two 500 KVA generators to supply 100 percent of the required emergency power for 30 days.

This view shows the guts of the rear protion system. Projectors and racks are on the right with the projection screens on the left. Final alignments and signal testings were being completed when this slide was taken. There are 86 screens on each side of the bunker. Images are supplied by computer controlled projectors. The entire UP rail system is projected upon these screens.

The first train was dispatched from the Harriman Dispatch center on April 15, 1989, about eight months after construction started. This view was taken during May, 1989. It shows the final configuration of the entry plaza and parking area to the south of the Dispatching Center. Final landscaping was being installed. You can also see the ConAgra corporate headquarters buildings to the east and north.

Today the Harriman Dispatching Center is fully operational and is controlling over 700 trains on 23,000 miles of track 24 hours a day. Eight hundred full time workers use the Center.

This slide shows the completely restored head house area with the cornice and parapets. This view is of the new eastern main entry and entry plaza. This view shows the old freight house and the new computer center with the historic granite cobblestones reinstalled to create the ambiance and texture of the old historic site.

This is the open office area on top of the bunker which contains the crew calling and time keeping functions. All lighting is indirect which highlights the magnificent space and historic iron trusses. It is a unique and exciting space in which to work. Here you see the edge of the bunker and the original exterior wall of the freight house. Glass railings were utilized to surround the top of the bunker to minimize visual intrusion of the new structure in the historic space.

This is the walkway between the bunker and the existing building. The bunker's concrete surface is exposed as is the existing brick wall in an honest and straightforward manner.

At the third floor of the head house a new conference room was created. The existing wood beams and rafters are left exposed creating a comfortable but unique space. This view is within the heart of the dispatching bunker from the upper crew management platform. You can see the rear projection screens on both sides of the bunker on which the Union Pacific rail system is displayed.

A dispatcher has this perspective from a typical dispatching work station. A dispatcher can see a schematic of the section of the rail system on which they are working and can monitor, control and interface with the crews on the trains from their station.

We feel the entire complex has been a successful combination of Union Pacific's history as well as the latest in communication and control technology.

Thank you very much for your attention. I would also like to thank Union Pacific once again for the opportunity to work on such an important and revolutionary project for the transportation industry. Thank you. (Applause)

President Burns: Thank you, Mr. Worth. We'll now have a short recess and reconvene here at 10:15.

Recess

President Burns: At this time I would like to turn the program over to Ron Poulsen who will introduce our next speaker. Ron.

Mr. Poulsen: We have a schedule change and are going to change the program. At this time we were to have a keynote address by Galen Reser from the Department of Transportation. Last December the Roadmasters Board of Directors decided it would be very interesting to hear what our Department of Transportation and the well-publicized Transportation Policy was to be, but Friday we had a cancellation from this gentleman so obviously they haven't put their transportation policy together yet. (Laughter)

We are going to move Dr. Gary Lewis who was scheduled at 11:15 a.m. to present his address now and then right after that the Union Pacific Railroad has more than willingly donated a 25 minute video on track buckling.

Dr. Lewis currently works at HDR Engineering in Denver, Colorado, as a senior project manager in hydraulic engineering. Gary has personally been involved in evaluating replacement structures of more than 300 railroad bridges and culverts in the Great Plains and south central states. Many of you have been contacted by his design teams.

Gary considers himself a native of Montana, Wyoming, Nebraska, and Colorado. He holds three degrees in civil engineering, including a doctorate from Colorado State University. His master's program at Montana State emphasized bridge hydrology and his doctoral work at CSU involved bridge hydraulics and scour.

He is the author of more than 70 publications in hydrology and hydraulics and recently completed the third edition of his textbook, ''Introduction to Hydrology'', used in more than 80 universities around the world.

In addition to more than ten years of consulting experience in bridge hydraulics and numerous other phases of water resources engineering, he spent more than a decade as a professor of civil engineering at the University of Nebraska, and another five years as an employee of the U. S. Geological Survey and the Bureau of Land Management. While at the University of Nebraska, he served two years as director of Nebraska's Water Research Institute.

Dr. Lewis' presentation is a case study of a lawsuit involving flooding at a railroad trestle that had just been replaced with a smaller culvert. The location and particular railroad are not important, but the lessons learned should be of interest to all of us. He has been involved as an expert witness in a number of drainage and erosion lawsuits, and will draw from that experience in telling you how to avoid these cases in the first place, or how to survive your day in court if you find yourself in the middle of one of these lawsuits. Dr. Lewis.

BRIDGE AND CULVERT REPLACEMENT: YOUR DAY IN COURT

Gary H. Lewis, Ph.D., P.E.

Senior Project Manager
HDR Engineering

Thank you, Ron, for that introduction. I do appreciate the opportunity to speak to you today. I would like to make an observation that occurred to me while I was listening to Ron. I don't know if any of you noticed but the directors seem to be wearing about three different hairstyles. These hairstyles are parted, unparted and departed. (Laughter) I am a student of authoritative studies and it has been authoritatively proven that those of us who are kind of balding in the front are great thinkers and those of us who are balding toward the back, including myself, are considered great lovers, and those of you who are balding everywhere just think that you're great lovers. (Laughter) I have a presentation with some slides and a couple of them are construction slides and I have to apologize for the quality, they were about the best I could get, but I did want to have some of the site conditions established before this replacement was made so that you could see the kind of structure that existed there beforehand.

Introduction

Many of the railroad companies in the United States are actively involved in replacing failing or failed bridges and culverts. These programs are managed in large part by the individuals present today. One of the key questions each of you are faced with when considering a bridge replacement is whether you should do anything but replace it in kind. Culvert replacements pose the same dilemma.

If a structure size is changed, will it increase risks to upstream or downstream properties? Isn't any change at all likely to invite a lawsuit just because you changed the size? Shouldn't we simply replace all bridges and culverts in kind? What are the standards we should use for designing replacements? How will your design and construction practices stand up in court if a property owner thinks the change caused his damage? What are some things we can do to improve your chances of winning a drainage dispute, or at least not being considered negligent?

For the past five years I have been a consultant to the railroad industry, involved in evaluating replacements for several hundred bridges and culverts located throughout the central and northwestern United States. I have been invited to share in the fun at several drainage lawsuits as an expert in hydrology and hydraulics, and I thought you would like to go into the courtroom to see what goes on.

The paper that I am presenting today is a case study of one of these lawsuits. It involved flooding behind a replacement railroad culvert in Cheyenne, Wyoming, and the outcome should be of interest to you because it may have set a precedent for your company. By showing you some of the claims made by the plaintiffs (a group of 22 homeowners) and the defendant, it is my hope to show just how rough the court can be and to give you some sage advice on conducting your replacement programs in a litigation-preventive style.

Some of the pointers I hope to leave with you are:

1. To show you the kinds of things lawyers, experts, and your neighboring landowners will say about you.

2. To urge care on your part in correspondence with your design engineers and construction gangs regarding various opinions about replacements.

3. To suggest how you can reduce the ways you can be faulted when you become involved in one of these cases.

4. To urge you to adopt a standard for replacement of bridges and culverts and apply that criteria to all such replacements.

I'll present a few slides showing the storm and damages that provoked this lawsuit, and then I'll review some of the points made by the plaintiff's experts about how "terrible" the railroad had behaved. Then I'll show you how the railroad attempted to defend itself. At that point, we'll pause and see how you would have voted if you were the jury. Then I will show you how six Cheyenne residents voted, and we'll look at some lessons learned and see what we can all do to prevent these kinds of problems in the future.

The Lawsuit

The case involved a class action filed against the Union Pacific Railroad Company for installing a five foot diameter culvert to replace a larger, deteriorating trestle. The trestle, constructed in the late 1800s to allow passage of the Burlington Northern track beneath the UP main line, was in need of repairs, and a main line derailment had recently occurred.

The replacement was sized by frequency-based methods to discharge the 50 year peak flow rate, with only a nominal surcharge during the 100 year event. During the trial, it was shown that the selected structure would have safely passed more than a 500 year event, but was not able to discharge flows from a freak storm that occurred August 1, 1985. Backwater pounded to a depth of 16 feet, flooding more than 20 basements in one subdivision.

The culvert location and flooded property are shown in Figure 1. A cross section of the embankment is given in Figure 2. The 125 acre foot detention cell just upstream of the trestle had been constructed a few years earlier by the Wyoming Highway Department (WHD) as part of a major roadway project to control runoff from upstream development and to protect Interstate 80 downstream.

The homeowners in the Sun Valley subdivision (Figure 1) filed for about $1,000,000, claiming $577,000 in flood damages and the remainder as legal, appraisal, and engineering and court costs. Claims included damages for lost employment, a $10,000 loss for four photo albums, and a $1,000 loss for a high school diploma. Based on separate damage appraisals, a stipulation of damages was made mid-course in the trial, setting the amount at $377,500.

The case was tried in Federal District Court in Cheyenne, Wyoming, in late August, 1986. Negotiations to settle out of court were unsuccessful, including a pretrial railroad offer of over half the final jury award.

The Storm

On the afternoon of August 1, 1985, a large, stationary storm cell developed over Cheyenne. Intense rain and hail occurred for several hours, ending about midnight. Portions of the community were covered with four feet of hail, some up to two inches in diameter. Three tornadoes were reported as part of the same system. The 12-mile diameter cloud ranged up to 65,000 feet.

A total of 7.75 inches of precipitation was estimated at the storm center. The airport weather station recorded 6.06 inches between 6:20 and 9:45 p.m. The average precipitation depth on the watershed above the culvert location was 4.77 inches, based on a U. S. Weather Bureau isohyetal map. The rainfall intensity peaked at 3.51 inches per hour at 8:30 p.m. The National Weather Service described the storm and flash flood as "monstrous", "clearly abnormal", and "very rarely occurring over populated areas".

The 6.06 inch depth is a record 3.5 hour amount for the community. For comparison, the 100 year and 500 year National Oceanic and Atmospheric Administration Atlas 2 rain depths for the same duration are estimated as 2.7 inches and 3.1 inches, respectively. The three hour probable maximum precipitation (PMP) is 13.7 inches, and the average annual rainfall at Cheyenne is about 12 inches.

The depth-duration-frequency (DDF) curves for Cheyenne are shown in Figure 3. The August 1, 1985, depth is about two inches more than the corresponding 500 year depth. Figure 4 shows the 3.5 hour rain depths, which are log-linear for frequencies below 100 years. Extrapolation of Figure 4 places the 1985 storm beyond the 10,000 year limit of the logarithmic abscissa.

A total of 12 lives were lost as a result of the storm, most of them due to drivers attempting to cross flooded intersections. The currents were too strong for safe passage, and swept the cars into deeper locations. Seventy others were injured. No physical injury or loss of life

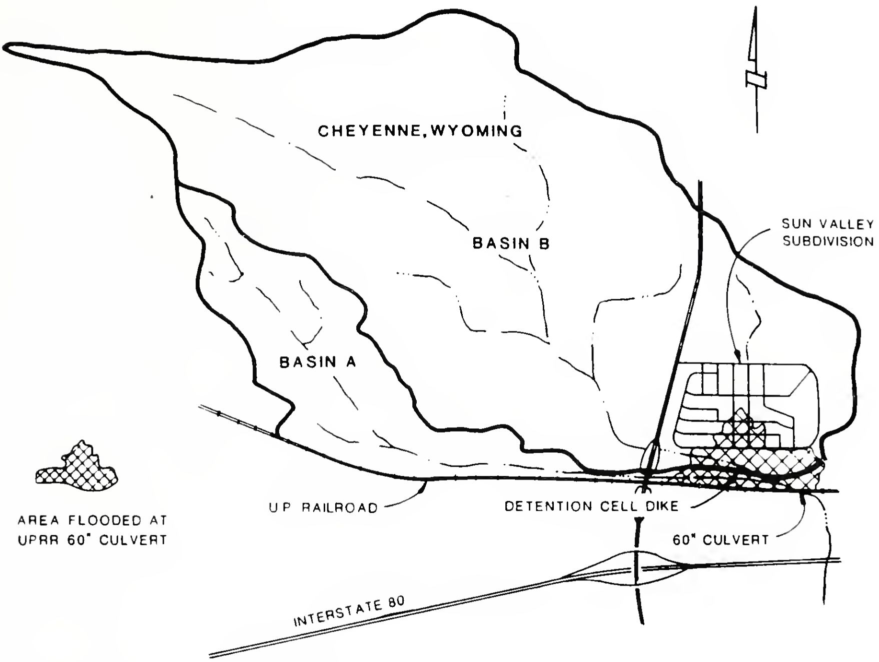


Figure 1. Culvert Location and Area Flooded by Railroad Culvert.

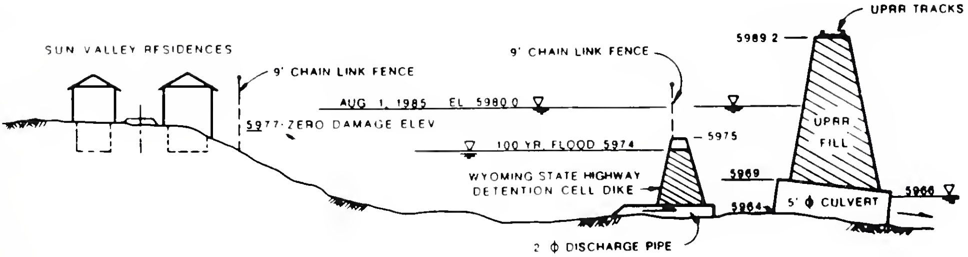


Figure 2. Elevation of Culvert, Detention Cell and Residences.

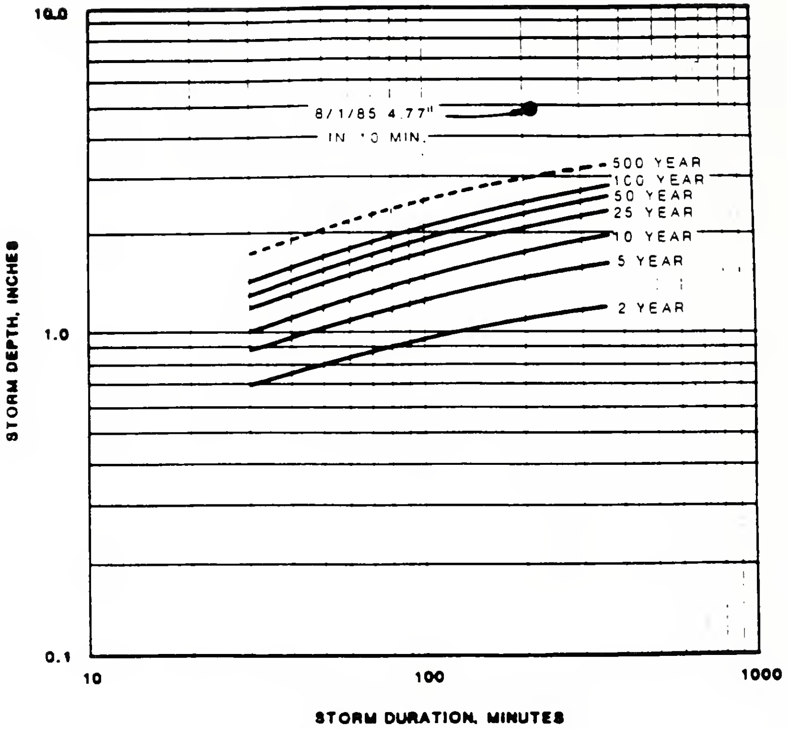


Figure 3. Depth-Duration-Frequency Curves for Cheyenne, WY.

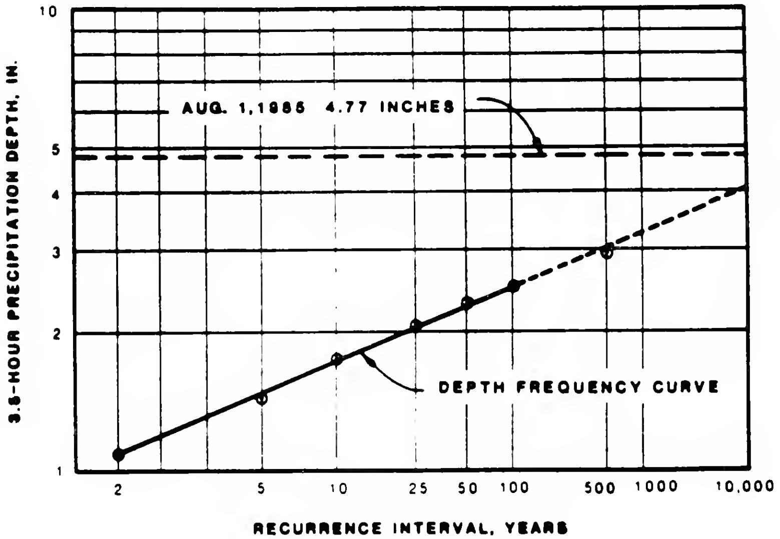


Figure 4. Frequency of 3.5-hour Rain Depths at Cheyenne, WY.

occurred at the railroad culvert. One estimate of total economic losses in Cheyenne was around $60 million. A special interagency task force report (FEMA 1985) estimated that only 137 of the 1,544 damaged properties were enrolled in the national flood insurance program.

Defense

The two principal assertions by the railroad were that standards of practice had been used in the design, construction and maintenance of the culvert, and that the storm was an Act-of-God event, far in excess of normal engineered designs, and could not have been anticipated.

The railroad's designer testified that both a 50- and 100-year Rational method discharge were calculated from the 166.4 acre subarea between the culvert and the Wyoming Highway Department detention cell (Basin A in Figure 1). The design calculations show that they were 101 and 115 cubic feet per second, respectively. For Basin B, the railroad estimated that the brink-full discharge from the detention cell would be 45 CFS. Assuming coincident peaks, flows from Basins A and B were added to obtain the total design discharge of 146 CFS per second.

The culvert manual used showed that the pipe would discharge the design flow with a 4.0 foot surcharge above the pipe. The corresponding level of 5,973 feet (Figure 2) was determined to be below the top of the detention cell, and the 60-inch pipe was accepted. The design was reviewed by the section head and subsequently approved for construction.

Several defense witnesses testified that the storm was a rare, freak occurrence, possibly as rare as once every 10,000 years. A representative from the National Weather Service presented details regarding the storm's unusual distribution of rainfall, hail and tornadoes.

Standards and criteria from a number of applicable design manuals were surveyed and reported to the jury. As shown in Table 1, some allow less than a 50 year design, and none generally recommend anything greater than a 100 year event. The 60 inch culvert was expressly designed for a peak flow somewhere between a 50 and 100 year event, and the adequacy against backwater flood in a 100 year event had been checked.

TABLE 1 — APPLICABLE CULVERT DESIGN CRITERIA

Agency (1)	Design Storm Criteria (2)
Union Pacific Railroad	50 year, then evaluate effects of 100 year storm
American Railway Engineering Association	25 to 50 year
City of Cheyenne	100 year on major drainage systems
Wyoming Highway Department	100 year, or flood of record if > 100 year
Federal Highway Administration	50 year minimum, interstate highways
Laramie County	Use city criteria in urban areas

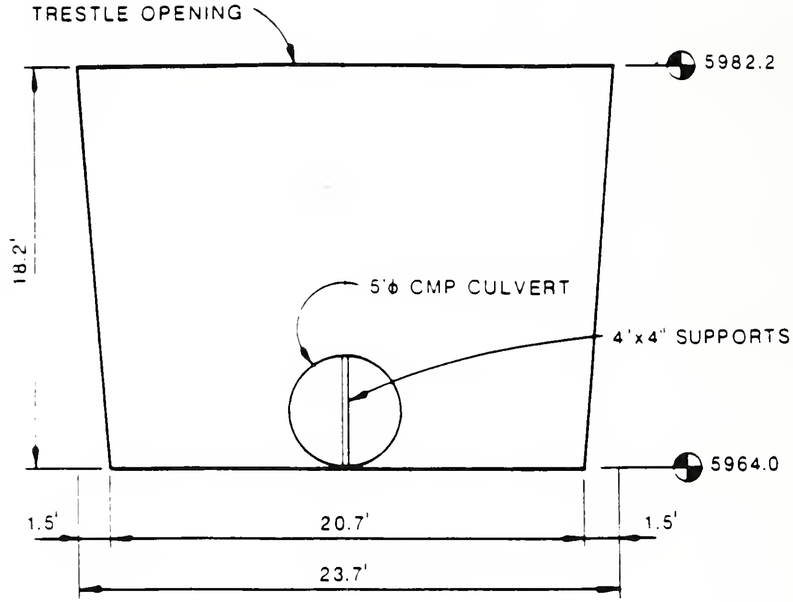
To prepare for the defense, the railroad's expert prepared a Storm Water Management Model (SWMM) of the two drainage areas above the detention cell and culvert. The computer model was used to answer the following questions:

Question 1. Did the detention cell contribute to the damage?

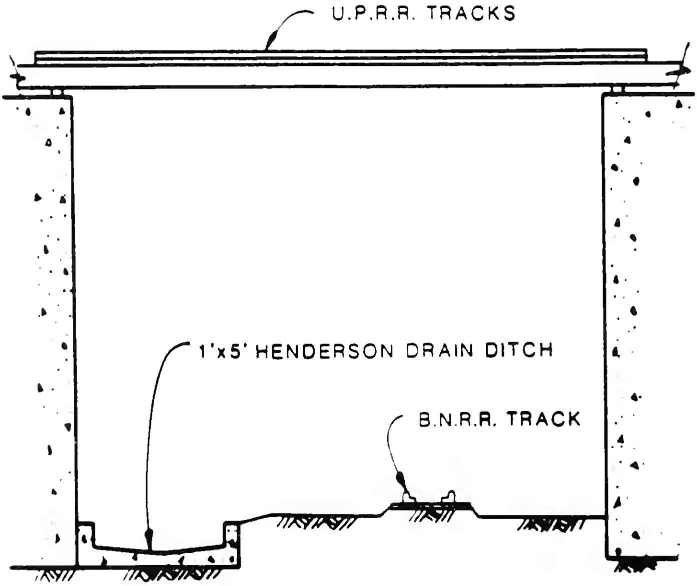
Result: No. The model was used to test the storm assuming with the original trestle and detention cell configuration. The basements would not have flooded if the culvert had not been installed.

Question 2. Does the installed culvert meet applicable standards of practice of the engineering profession?

Result: Yes. The defense proved that the installed culvert would safely pass not only the 50 and 100 year storms, but also a storm in excess of the 500 year event, without flooding the properties. The fact that the culvert would easily pass 100 year or greater floods was described as ''serendipitous'' and ''happenstance'' by the plaintiff.



(a) Plaintiff's Exhibit to Support Claim of 18-fold Reduction in Flow Area



(b) Actual Hydraulic Facility at Former Underpass

Figure 5. Plaintiff's and Actual Views of Former Underpass

Question 3. If all of plaintiff's alleged design "errors" and acts of negligence had not been made by the railroad, would the culvert have been sized large enough to have prevented flood damages for this particular storm?

Result: No. The defense conducted an analysis of the culvert size that would most likely have been selected if all of plaintiff's asserted errors had not been made. This revealed that for a 50 year design storm criterion, the 60 inch culvert size would not have been increased. For a 100 year criterion, a 72 inch diameter pipe would have most likely been selected using railroad procedures, although a 60 inch size could also have been accepted. The 1985 storm was subsequently simulated with a 72 inch diameter pipe, revealing that flood depths would have been only slightly less (about 0.5 feet) than occurred with the 60 inch pipe.

Plaintiff's Case

The plaintiff described the railroad's use of the Rational formula in this case as "inadequate, improper, and inconsistent with accepted practice". The railroad had applied the Rational formula to the 166 acre Basin A, and then added the peak discharge from the detention cell which was designed to control runoff from Basin B of Figure 1. This use of the Rational method for small watersheds is a widely accepted, conservative practice. The railroad's SWMM analysis showed that the Rational method actually over-predicted the flow rate from the combined areas A and B, even after area A was increased to a larger size than had been suggested by the plaintiff.

Plaintiff testified that the 1985 storm could not be considered an Act of God because it could have been foreseen. This claim was based in part on a 1955 storm that produced an estimated peak flow rate of 2600 CFS about halfway between the culvert location and Interstate 80 (Figure 1). The WHD used this same storm in sizing their detention cell - their estimate of the 1955 runoff volume (125 acre feet) was selected as the detention cell capacity at its spillway level. The cell was designed to store the entire storm volume from this event and discharge it at a controlled rate of 36 CFS (the 45 CFS rate was for another location) toward the railroad trestle.

The WHD considered the 1955 storm to be substantially greater than their estimated 50 or 100 year event. The plaintiff asserted that because the historical 2600 CFS peak flow rate was similar to the estimated peak for the 1985 storm, the 1985 storm was "the same", should have been foreseen, and was not as rare as suggested by the defense. It was also asserted (with no foundation provided) that the culvert would also cause flooding of plaintiff's property during a repeat of the 1955 storm.

The facts disprove these claims. The available rainfall records show that the 1955 storm depth was 2.68 inches measured at the same station that recorded 6.06 inches in the 1985 storm. The volume of runoff at the detention cell from the 1955 storm had been estimated by the WHD as 125 acre feet, compared to 590 acre feet calculated for the 1985 storm at the same location. The peaks may have been similar, but rain depths and runoff volumes were quite different. More importantly, the WHD detention cell had been designed to completely eliminate impacts of another 1955 storm. If the 1955 and 1985 storms had been "the same", the detention cell would have contained both, discharging them at a peak rate of 36 CFS. The actual peak flow rate over the cell embankment exceeded 2000 CFS.

The plaintiff claimed that the railroad should have contacted the WHD and would have subsequently recognized that the detention cell relied upon continued existence of the trestle opening, creating a prescriptive easement to the waterway. Several facts refute this argument. Early planning documents for the WHD detention cell contained the following note regarding downstream openings:

"...downstream drainage therefore only requires nominal size pipes (roughly larger than a 24 inch pipe) to accommodate local drainage, and the discharge from the peak depletion (sic) pond."

The designer was criticized by plaintiff for not using a railroad technician's recommendation that a single 14 foot diameter culvert be installed. This size had been incorrectly estimated from Talbot's formula, treating all the drainage area above the cell as though uncontrolled by the cell. Paradoxically, when Talbot's formula is applied to the correct drainage area, the formula requires a five foot diameter pipe. The technician, a former railroad employee, testified against the railroad, as did several other former employees.

The railroad was accused of being negligent because the detention cell information they received applied to a different cell, just east of the WHD cell. This error was conceded, but its relevance was not made clear during the trial. The correct detention cell information showed a design storm outflow of 36 CFS, which is 20 percent less than the 45 CFS rate estimated by the railroad.

The defendant was criticized for not providing a secondary passageway for floods greater than the design storm. It was further claimed that such a practice is "always" done, that the absence of a secondary outlet demonstrated negligence on the part of the railroad. In rebuttal, it can be argued that modern small structure design practice involves consideration of major storms, not catastrophic storms. The railroad had evaluated both the 50 and 100 year flood events, and determined that neither would back water over the detention cell dike. The 100 year discharge is considered by most to be a mshowajor event.

A universal requirement for costly secondary passage is questioned for culvert locations having ample storage space for a wide range of reasonable foreseeable events. Storage at this site was an obvious intention on the part of WHD. The storage capacity is very large when compared with most culvert locations in urban areas. Detention produces downstream benefits and is often substituted in place of expensive secondary outlets. If no replacement culvert had been provided at all (i.e., had the opening been completely blocked), the storage capacity at this site would easily contain all the runoff from a 100 year, 3.5 hour storm, with virtually no damages.

Graphics were used to emphasize points by the plaintiff. For example, Figure 5a was shown to the jury to claim that the railroad "improperly downsized the trestle 18-fold" by decreasing its area from 360 to 20 square feet. The basis for conveyance must be hydraulics, not open area, as asserted by Figure 5a. Many large trestles built during the early days of railroading, especially at high fill locations, have been safely replaced by culverts or bridges with much less end area than that exposed by the trestle. Only a flood approximately a repeat of the Genesis deluge would have caused water to flow 18.2 feet deep to the top of the embankment, occupying the full 360 square foot area of the original trestle.

The relevant question is whether the entire original trestle opening was a hydraulic structure, in light of its primary purpose of creating passage for another track, and whether the new culvert provides safe conveyance (or storage) during typical design storms used by our profession. The actual configuration is shown in Figure 5b, which was not shown to the jury. The original trestle had a low-flow channel approximately five feet wide and about one foot deep to pass flows from the upstream drainage. This hydraulic feature had about the same cross section as the channel upstream of and downstream from the trestle. This structure, as well as the installed 60 inch culvert, would safely pass more than the 500 year event.

The plaintiff claimed that the 166 acre surface area used by the railroad for Basin A was inaccurate. This assertion was based on recent two foot contour maps. However, these were not developed until after the design was complete and were, therefore, irrelevant.

Actual drainage areas are still uncertain; however, the defense's SWMM model showed that use of the larger area, in combination with other "right" choices, would not likely have increased the culvert design size.

The plaintiff testified that the culvert should have been designed for a greater recurrent interval than 50 years. The assertion was not accompanied, by the way, with plaintiff's recommendation of the appropriate design frequency. This would require plaintiff to prescribe a frequency, and they already agreed that the structure would safely pass almost an 8000 year event.

The railroad was further criticized for not installing a trash rack and antivortex device on the culvert inlet and was condemned for allowing the contractor to leave some debris on site and wooden stays in the pipe. In fact, the detention cell is completely surrounded by a nine foot high chain link fence (Figure 2) that would prevent debris from entering the cell from the Sun Valley subdivision. Any debris that entered the cell could not flow out because of the encircling fence. The Basin A (Figure 1) watershed is quite distant from the culvert location and would require transport of any debris by a long, shallow ditch along the railroad siding. No evidence showed that debris actually obstructed the culvert or caused flooding.

The railroad was criticized for not using a computer to design the culvert. Plaintiff's experts would not produce the "proper" design size that would have resulted from their model, but asserted that the railroad should have used a model. Defense proved that even if a model like SWMM had been used, or if modern risk based methods of analysis had been applied, a smaller rather than larger pipe may have been suggested.

Finally in this list, but not in the courtroom, the plaintiff criticized the railroad for not considering the increased risk of flooding. This assertion had a significant impact on the jury. The only testimony the jury heard regarding risk was that provided by the plaintiff's lawyer and witnesses. Two claims were made—that the railroad carelessly failed to account for risk in the design of the site, and that a 20 fold increase in risk was imprudently invoked.

In rebuttal to the first claim, it can be reasonably argued that frequency-based designs do in fact incorporate risk, primarily through the inverse relationship between the selected design recurrence interval and exceedance probability. Only the damage probability is omitted from the classical definition of risk. In this case, the railroad's 60 inch size, or smaller, would have been selected had the most modern risk-based design techniques available been applied.

The second reference to risk was a result of comparison of the 50 year flood risk before and after installation of the 60 inch culvert. This analysis required that the plaintiff had to estimate the marginal probability of the 1985 storm with sufficient confidence to testify that the associated 20 fold increase in risk is a relevant fact.

It was neither relevant nor scientific. An improper marginal probability, T, for the 1985 storm was used by the plaintiff to arrive at their twenty to one conclusion. It can be shown that the value of T that had to be assumed by the plaintiff is 10,000 years. The extrapolation for use by a jury of a recurrence interval of 10,000 year magnitude, using only 80 to 90 years of historical rain data, is not substantiated in the literature or anywhere else in science.

The Wyoming Highway Department testimony included statements that the 20 fold risk increase appeared valid, but they also testified that extrapolation beyond 100 years is not reasonable. Neither the WHD, nor the jury, apparently identified the link between the "20 fold risk increase" and the prerequisite extrapolation of the 90 year rainfall record to a 10,000 year value.

It was suggested to the jury that the current Sun Valley homeowner's risk of flooding during a 50 year period is one in ten. They weren't told that this is quite small compared to accepted risks of millions of people living in residential developments across the country. A typical property having its basement window at the 100 year flood plain fringe along a stream has an annual risk of only 0.01, which is five times greater than the risk to Sun Valley residences behind the railroad's 60 inch culvert. If extended over 50 years (this is often done just to increase the risk magnitudes), the same typical basement has only a 39.5 percent probability of flooding at least once. This is still almost four times greater than the approximate 50 year risk of 10.0 percent for the homeowners behind the 60 inch culvert.

The plaintiff's claims regarding risk were not founded. They were exaggerated, and context was not developed for the jury. Through legal maneuvering, the defense was not allowed to address risk questions or disclose the problems with some of these assertions.

The Verdict

The trial was held July 24 through August 1, 1986, ending exactly one year after the storm. A jury of six, five of whom reside in Cheyenne found the defendant guilty and liable for the stipulated damages. They concluded that the damages were not exclusively an Act of God and that the railroad was negligent in either its design, construction, or maintenance of the facility so as to "proximately cause" the damages. The jury was not required to articulate in which area the negligence occurred. Plaintiff was critical of defendant's actions in all three areas.

The railroad was found to have created either an intentional, reckless or negligent invasion of the plaintiff's property interests. It was further concluded that the homeowners had developed a prescriptive easement to the trestle opening and that the replacement was an unreasonable use of the former trestle site. The culvert was determined to be a continuing nuisance, and the judge ordered that the railroad present a design for its replacement within 30 days.

The plaintiff's arguments for inverse condemnation were not supported by the jury. The jury awarded damages to the plaintiffs equal to the stipulated amount, but did not award payment of the engineering and litigation costs to the plaintiff's attorney or witnesses.

Replacement Issues

Several results of this jury verdict may significantly affect your replacement decisions. The court ordered that the 60 inch culvert be replaced with a "necessary and adequate" structure. These abstract terms were used in the order, but the court gave no engineering guidance or criteria. With a 30 day period, a proposed replacement was offered by the railroad, but rejected by the plaintiff. The proposal included a second 60 inch pipe, placed perpendicular to the embankment. No calculations were incorporated because it was felt that twice the capacity of what was already adequate by engineering standards would certainly be adequate.

This action angered the lawyers and engineers working for the plaintiff and initiated debate over selection of criteria for designing the replacement culvert, since the design had to be documented and certified by an engineer. Of interest, plaintiff did not propose the use of a risk-based method, even though their testimony was that the railroad should have given adequate consideration to risk. It can be shown that a risk-based analysis would allow reinstallation of the existing culvert, even when the 1985 damages are included.

Three options were discussed in sizing the replacement: a frequency-based design storm, provision of equal conveyance for a selected storm, and sizing to eliminate damages from a repeat of the freak 1985 storm. The engineers involved (not including the author at that time) could not agree on an appropriate frequency for replacement, because the existing culvert would safely discharge all storms that have reasonably determinable frequencies (i.e., up to 500 years).

A structure that would provide equal conveyance was discussed, but the engineers could not agree on how much of the opening was a hydraulic structure and which design storm should be used to establish "equivalence". Limiting the damages from a repeat of the 1985 storm was eventually adopted as the basis for design of the replacement. Note that this gives no guidance to us for our task at hand.

Once a consensus to use the 1985 storm was reached, a further debate broke out regarding the design backwater elevation that should be adopted. The engineers reached initial consensus to allow the water to rise to 5,976 feet (Figure 2), giving a one foot freeboard level below the lowest zero-damage elevation. The plaintiff's lawyer contended that his client had a prescriptive easement to the original trestle, and that water levels should not be allowed to rise any higher than with the original trestle, even though damages would not be incipient. Plaintiff's engineer then changed positions, and agreed with the attorney.

Both sides eventually agreed that a maximum allowable water level during a repeat of the 1985 storm should be 5,976, one foot below the zero-damage elevation. The engineers were then unable to agree on the combination of new culvert sizes that would result in this maximum allowable elevation. Caused by using different models of the watershed, the disagreement eventually narrowed to about one foot of pipe diameter. Two additional 72 inch sizes were proposed by the railroad's detailed model. The judge finally resolved the matter by ordering installation of plaintiff's HEC-1 based plan which called for new 72 and 84 inch culverts.

LESSONS LEARNED — DESIGNS OF REPLACEMENT STRUCTURES

Railroads currently involved in replacing bridges and culverts should view the criticisms made by the plaintiff, and the jury's verdict of "guilty, liable, negligent, and creating a nuisance" as potentially addressable to their designs. The principle that prudent application of established engineering standards should provide an adequate defense in a clear Act-of-God case was challenged by the outcome of this dispute. Plaintiff's witnesses would not agree that the flooding was an Act of God, but one of them admitted that the storm was a "God-send" because of all of the employment contracts being received from other flooded landowners.

The outcome suggests that consideration of a catastrophic event should be included in the design file for replacement structures. The file should also be free of unanswered suggestions for replacement structure sizes, and replacements should be designed by a trained, experienced engineer. Many allegations were made in the Cheyenne case that things not done (no trash rack, no analysis of piping, no outlet protection, no visiting site, etc.) were somehow related to the damages and reasons for a negligence verdict. This suggests that design files must also list what wasn't done and why.

The culvert met even the most conservative of the applicable standards, yet the designer was considered negligent. If a clearer statement of engineering standards for design of culverts existed, it might have helped in preventing the negligence ruling. Only the reasonableness and prudence in applying the standards should be tried, not the standards themselves. Negligence should be addressed within the professions rather than in the courts.

The trial may have set some precedents for future cases, and will likely appear in the citations by attorneys in any transportation drainage litigation. The case also left some questions unanswered.

The following questions will continue to be raised each time something like this happens:

1. When a structure is sized for a given frequency storm, are the engineers and/or owner necessarily liable when storm events in excess of the design frequency cause damages? Are they necessarily negligent?
2. When does the damage from floods in freak storms become an Act of God?
3. If an installed structure exceeds all known standards of practice, but a jury or judge orders a replacement, what standards should be used to replace it?
4. When an engineer's design procedure and file contents are addressed in court by another engineer, should criticism of the work be offered and/or allowed if not accompanied by foundational documentation that the claimed faults actually contributed to damages?
5. Is it appropriate for professional engineers to testify that other engineers are ''negligent'', without previously (or at least concurrently) filing a formal negligence complaint with the state registration board or appropriate ethics committee of the profession?

Thank you for allowing me to share these courtroom experiences with you. Most of the lessons are obvious, and I hope that your bridge and culvert replacements will have fewer pitfalls as a result of your visit to this courtroom. I would be very happy to hear from some of you regarding your experiences, and to talk about what we might do to prevent future recurrences of these problems. (Applause)

Mr. Poulsen: Thank you, Mr. Lewis for bringing us up to date in the courtroom.

Four years ago the United States railroads were suffering a little bit with sunkink problems and the FRA got involved and asked the railroads what they were doing to prevent those sunkinks and the Union Pacific decided that one of their problems was the lack of training of our people in the field because we had so many new people out there. The following is a short video that we call ''Rails That Grow.'' It was developed as a training program which we present to our field track people annually before the hot weather hits us. So without any further ado, we'll dim the lights.

RAILS THAT GROW

(Video presentation courtesy of the Union Pacific Railroad)

President Burns: I would like to thank all of this morning's speakers for taking the time to be with us. I would also like to thank the Union Pacific for providing the video. I want everyone to note that the B&B session will reconvene at 1:30 p.m. in the State Ballroom and the Roadmasters will reconvene here in this room also at 1:30 p.m. This session is now adjourned for lunch.

MONDAY AFTERNOON SESSION

September 17, 1990

B.T. Burns

President Burns: I hereby bring the 95th Annual Conference of the American Railway Bridge and Building Association to order. On behalf of the Association officers and myself, I wish to extend a warm welcome to all members, guests and friends. This morning's registration is 75 B&B, 139 Roadmasters, 127 Guests, 144 Associates, 84 ladies, for a total of 569.

Over the past several years, both at the annual conferences and in the President's letters in the B&B NEWS, the members of this Association have been urged to ''Get Involved''. One way of doing this is to participate in a committee or a special subject report. I urge all of you to take the time to contribute your knowledge and experience to one of next year's reports. It is the involvement of you, the members of the B&B Association, that makes the annual conference a success.

At this time your association is doing well, both financially and in the number of members. However, with the current trend in downsizing that the Class I roads are experiencing, it is important that all of you promote your association and encourage individuals within and outside of your respective organizations to join. I would ask all of you to think of any individuals who are involved in railway bridge or building work and, if they are not already members, make them aware of this Association and its goals. A constant influx of new members is essential to the continued health of the Association.

As many of you may be aware, I have served on the Executive Board of this Association for the past seven years. During that time, I have made many new friends and have gained a wealth of knowledge. It has been a personally rewarding experience that will be one of the highlights of my professional career. I want to thank all of you, the members and particularly the officers and staff of the Association, for the support which you have given me during my term as president.

Now I would like to turn the program over to Bob Carter who will introduce this afternoon's first presentaton. Bob.

Mr. Carter: Thank you, President Burns. Our first report this afternoon will be Special Subject No. 1, ''Proper Rigging Procedures'' by Chris Covill and Carl Young, both with Conrail.

SPECIAL SUBJECT NO. 1

Proper Rigging Procedures

Co-chairmen: C. R. Covill, Asst.Supv.Strs., Conrail, Northwood OH
C. W. Young, Proj.Engr., Conrail, Dearborn MI

Committee: D. L. McCammon, Mgr.B&B, BN, Englewood CO
W. H. Nelson, Mgr.M/W. Trng., BN, Overland Park KS
R. Cacchiotti, CN, Montreal Que
A. S. Uppal, Mgr.Br.& Strs., CN, Edmonton ALB
R. J. Kelly, Mgr.Strs., C&NW Transp., Boone IA
C. M. Russell, Asst.DE-Br., NS, Decatur IL
H. B. Matthews, Jr., Br.Insp./Supv., Port Authority of Allegheny County Transit, Pittsburgh PA
W. S. Riehl, Civil Engr., Seminole Gulf, Ft. Myers FL
H. Roecker, Mgr.Strl.Engr., SEPTA, Philadelphia PA
B. E. Williams, Asst.Mgr.Engr.Trng., UP, Salt Lake City UT
J. Cliff, Spandeck, Inc., Franklin TN

Introduction

Rigging is an everyday thing to the people who work around it frequently. Because it is commonplace, people have a tendency to ignore established proper procedures. They think, let me rephrase this, for out of habit and familiarity, they don't think and this can lead to unwanted situations. The name of the game is to do the job as quickly, safely and economically as possible. The quickest way to reach these ends is to do it properly.

Webster partially defines rigging as "to provide (ship) with spars, ropes, etc.; to equip.; manner in which masts and sails of vessel are rigged; equipment, used in erecting or installing machinery, etc.; system of ropes and tackle, esp. for supporting mast or controlling sails". Rigging as defined for our purposes here is a method of supporting loads as they are lifted.

Much like the familiar advertisement, we've come a long way baby. Rigging has developed extensively since man first began using vines as rigging. Today we have a variety of materials that are used, such as wire rope, chain, nylon and polyester webbing.

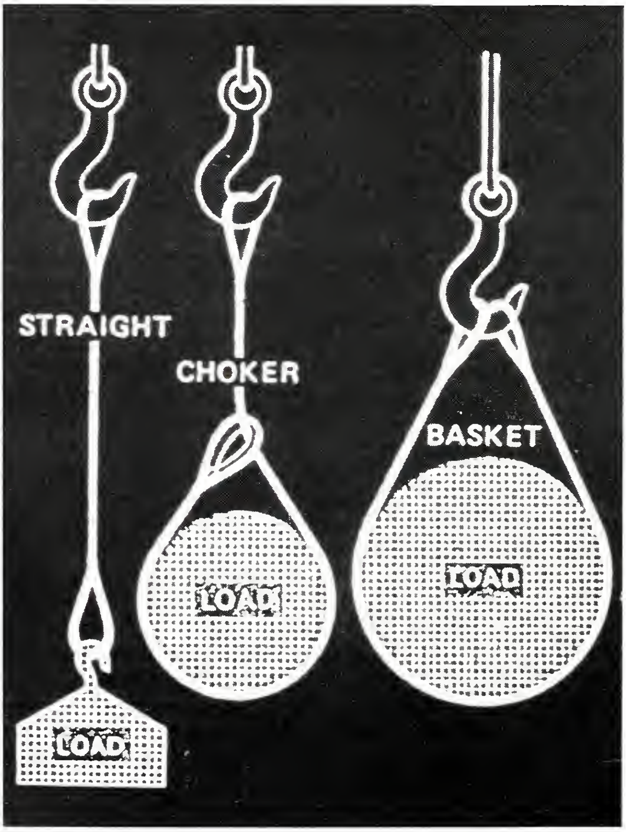
The design for rigging of a lift takes various factors into consideration, such as the weight of the load, the shape of the load, the center of gravity and the type of material that is to be picked or lifted. We will assume that, at this point, the crane capacity has already been established, because, like most construction you need a good foundation.

Loads to be picked do come in all different sizes and shapes, such as cylindrical, triangular, rectangular, etc.. Odd shaped objects have to be experimented with to find the correct attachment points. But in all cases, the block has to be over the center of gravity so that the load is spread evenly throughout the rigging and below the lowest point of attachments of the slings so that the load will not rotate during the lifting procedure. Even if the object to be lifted has symmetry, the weight may still not be evenly distributed. An object will usually tilt until the center of gravity is directly beneath the hook. By definition, center of gravity is that point at which an object will balance. The stability of the load is of prime importance.

Determination of what type of sling, based on the weight of the load, is next. Are we going to use wire rope, chain or nylon webbing. Load capacity charts are available for each type of material and can be referred to for capacity ratings.

Most slings used for rigging have three capacities, depending upon the style of the sling. There is the basket, vertical and choker style.

MAX LOAD AT HORIZ
LIFT ANGLE
LBS


STRAIGHT
CHOKER
BASKET
LOAD
LOAD
LOAD

The basket style has the highest capacity, the vertical has about half of the capacity of the basket hitch and choker has the lowest capacity of the three styles.

Let's discuss this a little bit more. A straight, or vertical, attachment is simply using a sling to connect a lifting hook to a load. Full rated lifting capacity of the sling may be utilized, but not exceeded. A tagline should be used to prevent load rotation which may damage the sling.

Choker hitches reduce lifting capability of a sling, since this method of rigging affects ability of the components to adjust during the lift. A choker is used when the load will not be seriously damaged by the sling body, or the sling damaged by the load, and when the lift requires the sling to snug up against the load. A choker hitch should be pulled tight before a lift is made, not pulled down during the lift. It is also dangerous to use only one choker hitch to lift a load which might shift or slide out of the choke.

The diameter of the bend where the sling contacts the load should keep the point of choke against the sling body, never against a splice or the base of the eye. When a choke is used at an angle of less than 120 degrees, the sling rated capacity must be adjusted downward.

Basket hitches distribute a load equally between the two legs of a sling. Capacity of a sling used in a basket is affected by the bend, or curvature, where the sling body comes in contact with the load-bending action as over a sheave. When two or more slings are attached to the same lifting hook, the total hitch becomes, in effect, a lifting bridle, and the load is normally distributed equally among the individual slings.

Design Factors

Geometry is a factor that has to be taken into consideration. As the included angle of the sling increases, the tension felt by each leg of the sling increases radically. Any time pull is exerted at an angle on a leg, or legs, of a sling, the load per leg can be determined by using the data found in tables that are available.

The calculation to determine the rated capacity required by a sling, or slings, is straightforward. Divide the total load to be lifted by the number of legs to be used. This provides the load per leg if the load is being lifted vertically by all the legs.

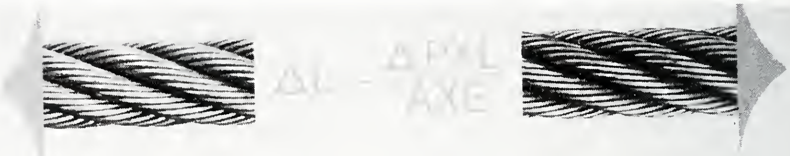
When there is an angle between the legs of a sling, these angles have to be determined. When three or more legs are used, the angle will be twice the angle between one leg and an imaginary line extending straight down from the lifting hook. The load for each leg is then multiplied by the load factor in the charts that are provided by many distributors. This computes the actual load on each leg for this lift and angle.

Let's assume that we are going to lift a load of one thousand pounds and the included angle is 60 degrees. We are using a two-legged bridle hitch. The load, on a vertical lift for each leg is 500 pounds, but by multiplying 500 by the load factor of 1.154 we find that each leg has an actual stress of 577 pounds. Let's increase the included angle to 90 degrees. The load factor increases to 1.414 which gives us an actual stress of 707 pounds. It should be noted that the leg angles of bridles with three or more legs must be measured differently than the angles of two-legged hitches.

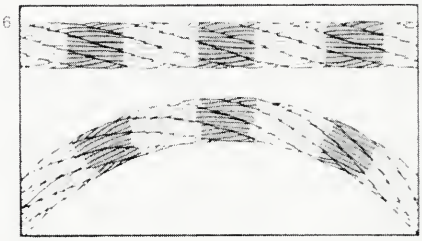
The establishment of a vertical line downward from the lifting hook as it would be positioned at the start of the lift is the first step. Next, measure the greatest angle (technically known as the half included angle) between this line and any one leg and multiply this by two. This yields the leg angle which is to be used to calculate the actual load on each leg of the bridle.

Where a sling contacts the load when a basket hitch is used the diameter of the bend can be a limiting factor on the capacity of the sling. The standard D/d ratio (upper case "D" being the diameter of the bend and the lower case "d" being the diameter of the rope) are applied to determine efficiency of various sling constructions. Examples are:

1. Mechanically spliced, single part slings: 20 times rope diameter.
2. Hand spliced, single part slings: 10 times rope diameter.
3. Braided multi-part slings of six and eight parts: 20 times component rope diameter.
4. Super-flex multi-part slings: 20 times component rope diameter.
5. Cable laid slings: 10 times body diameter
6. Hand tucked grommets and mechanically joined grommets: 5 times sling body diameter (the body of the grommet being rigid and contacts the lifting hook, the bend of the grommet limits the capacity more than bending contact with the load, and therefore prevails).



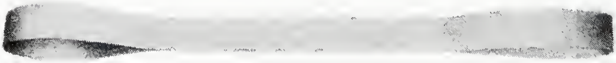
Wire Rope Stretch



Bending Stress

COPY .75 15

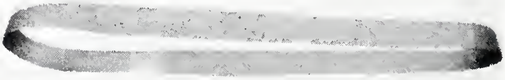
EYE AND EYE



STRAIGHT EYE TYPE III

TWIST EYE TYPE IV

ENDLESS



ENDLESS TYPE V

One item not discussed yet is the spreader beam. Standard spreader beams are made up with a structural steel beam suspended by a two-legged sling. The angle of the slings attached to the spreader has the same role as in the bridle slings and applies to the connection from the hook on the block to the connections on the top of the beam. Droppers from the bottom of the beam are attached to the load.

When a load is lifted by a sling, the legs of the sling will exert a lifting force and a compressive force at the same time. If the sling is attached directly to the load the compressive forces can crush or deform a fragile load. Therefore the use of a spreader beam absorbs these compressive forces.

Wire Rope

Many factors have to be considered in the selection of a wire rope, such as the type of wire rope it's made of, the type of splice and the type of fittings, with the most common being made from 6 x 19 or 6 x 37 improved plow steel with an independent wire rope core and a swagged (mechanical splice).

At this point, let's see what 6 x 19 and 6 x 37 means. A 6 x 19 rope indicates that there are six strands with each strand having 19 wires. A 6 x 37 rope has six strands with 37 wires. There are also hand spliced slings, hand braided six or eight part slings and other special fittings that go with the sling. The sling should be tagged from the manufacturer with the rated capacity stamped on the tag.

This brings up the inspection of the wire rope. You should check for the following:

1. Kinks—these are not repairable
2. Crushed
3. Abraded—worn
4. Flattened
5. Bird caged

If any of these defects are found, the sling should be taken out of service.

You should look for other types of damage, such as broken wires. Under normal and ideal conditions, wire will break on the crown of the strands first. A good way to check this is to run a cloth rag along the wire rope. It will catch on any exposed ends of broken wires. A visual inspection while flexing a sling can often expose broken wires hidden in valleys between strands that the rag inspections may have failed to pick up.

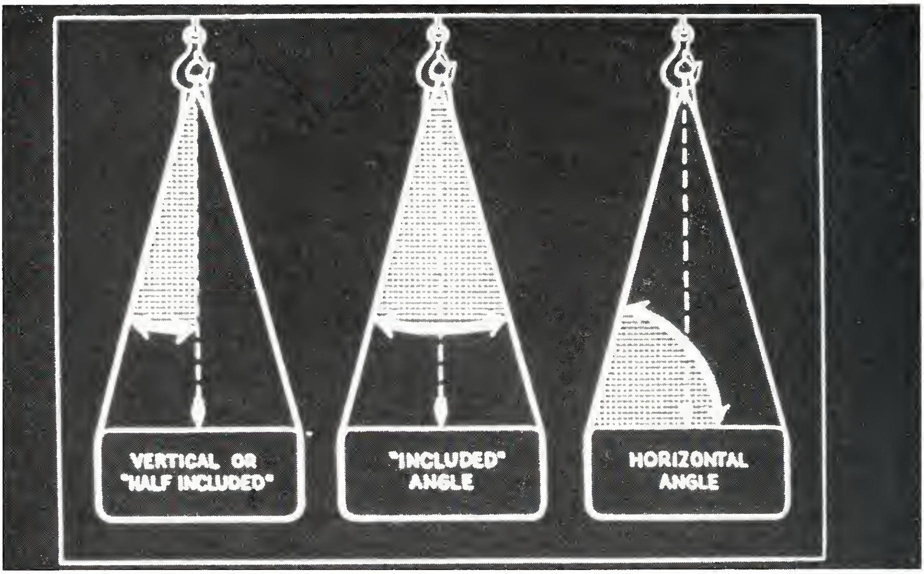
Particular attention should be paid at the point of the end connections since free movement of the wire is somewhat restricted at this point. This impairs the ability of the wires to adjust and move. This impediment of movement can result in breakage of the wires at this point. If broken wires are found, a more detailed inspection should be performed. OSHA regulations state that slings should be removed from service when ten randomly distributed broken wires exist in one rope strand or five broken wires in one lay. If there is wear or scraping of one-third or more of the original diameter from the surfaces of the outside strands, the sling should be removed from service.

You should check the condition of the fittings and other components of your sling for deformation. Are protective wire rope eyes used where possible and in good shape? The design of sling eyes is such that the eye is like a small inverted sling at the end of the sling body. With this in mind, we know that the same general forces apply as they do to the legs of sling rigged as a basket. Never use a sling over a hook or pin with a body diameter larger than the natural width of the eye. An eye should never be forced onto a hook. The eye of the sling should always be used on a hook or pin with at least the nominal diameter of the rope.

The eye of a sling should be checked for any permanent damage, such as elongation, which indicates that it has been overloaded and has been pulled beyond the steel's elastic limit. Is there any evidence of heat damage? Is it cracked or worn? Any of these conditions would necessitate the removal of this sling from service. Shock loading is a big offender.

Proper storage of wire rope slings is a must to insure a longer working life. It must be put up in a manner that allows for ready access and visual inspection for when it will be needed. They should be stored in a dry place, protected from grit and dirt. The sling must be properly lubricated.

A wire rope is a machine having many moving parts. Each time a rope bends or straightens, the wire in the strands must slide on each other, thus the need for a lubricant. Lubrication also helps to prevent corrosion. Lubricant may be applied with an oil can, brush or a rag. For maximum penetration, the lubricant should be applied while the rope is opened up. The best way to do this is to have the rope traveling



around a sheave or winding on a drum through an oil bath. A wire rope must be clean and dry as possible prior to the application of a lubricant. The most effective lubrication occurs when the dressing comes in contact with bare metal. If this is not done, the lubricant may not adhere. The objective is to apply a uniform coating to the entire length of the wire rope.

Wire rope is lubricated during the process of manufacturing. The amount and grade of the lubricant is determined by the size and type of rope. Periodic applications of a lubricant have to be made because the factory applications will not last the effective working life of a wire rope. A good grade of grease or oil should be used. It should be free of acids and alkalis; have sufficient adhesive strength to adhere to the rope; be able to penetrate between the wires and strands; resist oxidation; have a high film strength and be non-soluble under the conditions prevailing where the rope operates. A rusty rope is a liability since there is no means of visual inspection which can determine the remaining strength of a corroded rope.

Chains

The four most common chain slings are:

1. Single, which consists of a master link, a length of alloy chain and a hook.
2. Double, consisting of two chain legs, both connected to a master link at one end. Each leg has a hook at the other end. This is the most widely used.
3. The triple or three-legged is double with one more leg and hook. The triple is used to improve the stability of the load.
4. A quadruple or four-legged sling has the same rating as the triple since the load is seldom evenly distributed. The extra leg in this instance is also used for stabilization.

The load plays the biggest role in the selection of a chain sling. You need to know the weight, shape and center of gravity. Charts are provided to aid you in the selection of your sling. It will show you the diameters of the chain links that are available, the W.L.L. (Working Load Limit) for each diameter and in the cases where a two, three or four part sling is required, the W.L.L. at the various degrees that your sling will be working under, specifically a 30, 45 and 60 degree angle. It is recommended that the sling angle never be less than 30 degrees. The efficiency of your sling is greatly reduced. Also, hook-ups for magnets are available and indicated on the charts.

A chain is designated by a three letter code such as "SOS" which tells you that this is a single chain with an oblong master link of standard dimensions and a sling hook. This could be elaborated on a little bit more, but the designations are standard and can be found in literature obtained from various manufacturers. This information is necessary when you are ordering. If you are ordering a sling that does not fit within these configurations, you must be specific in your ordering.

There are four hooks that are basically used. They are: the sling hook which has a full wide throat; the grab hook with a designed narrow throat and used to shorten or hold a length of chain which allows the throat to engage the chain between the links for quick non-slip handling; the foundry hook which is designed with a wide, deep throat that fits trunnions and handles on moulds or castings generally used in foundry work; the latch hook which has a spring loaded latch that prevents the hook from slipping off the load before the sling is tensioned. There are other types such as the sorting hook used mostly by erectors on wire rope, and plate hooks for use when handling plates, flats and structurals. This type is designed for the most popular chain sizes and is proof tested to the same values as the chain they are linked with. This allows for the same working load limit.

Alloy steel chain is the only chain recommended for overhead lifting. Again, as with wire rope, each alloy steel chain must have a permanently attached identification tag from the manufacturer. This identification tag will state the grade, size, reach, type and working load limit at a specific angle.

Chain comes in varying grades. A Grade 30 is a low carbon steel general utility chain used for a great many everyday applications. Grade 40 is a higher carbon steel chain and is stronger than the Grade 30 and is used much the same way. Grade 70 is a high strength lightweight Boron manganese steel chain designed for loading binding applications. Grade 80 has a high strength-to-weight ratio. It is used predominantly for lifting and hoisting. Where optimum wear and strength is required, this is the grade used. Grade 80 is the only chain recommended for lifting and hoisting.

It is not recommended to use a chain sling where it will be subjected to acid or pickling solutions. The high tensile strength of the heated alloy steel material in alloy steel chains is susceptible to hydrogen embrittlement when it comes in contact with acid. Heat is another factor to be taken into consideration. As the temperature of the environment increases in which the chain is being used, the working load limit of the chain decreases.

The inspection of chain slings is critical and should be assigned to qualified personnel. These people should be given the authority to remove any defective chain from service. Each chain, prior to inspection, has to be cleaned. Dirt or oil may hide nicks, gouges or other damage. The legibility of the identification tag should be checked. Is the pertinent data still there? Does it still have the correct data as what is on file in the control file? Some companies have these, but not all. A measurement of the reach of the sling legs has to be done to ensure that the values stamped on the identification tag are still accurate. If one or more legs are longer, there is a possibility that the sling has been subjected to overloading, shock loading or excess wear.

A link by link inspection has to be made. Check for excessive wear, twisted, bent or cut links, cracks in the weld area or any portion of the link, nicks and gouges (transverse gouges are the most dangerous), elongated links and severe corrosion. The master and coupling links should be checked for wear or damage. Have the hooks been opened more than 15 percent of the normal throat opening (measured at the narrowest point) or twisted more than 10 degrees from the plane of the unbent hook? If this has occurred, the sling is to be taken out of service.

Excessive wear is also a cause for taking a sling out of service. Any defect that will cause a reduction in the capacity of the sling or cause it to break is reason enough to take a chain sling out of service.

Chains should always be stored in a clean dry area. If the chain sling is to be stored for any length of time, it should be oiled to prevent corrosion. A good grade of oil with the same properties described in the lubrication of wire rope is adequate. The area that the sling is stored in should be clean and give free access to the slings. Never store a sling on the floor, they should always be hung. This prevents other material from being stockpiled on them, causing deformation if the stockpiled material is heavy; the slings cannot be run over; a tripping hazard has been removed, and water or other material detrimental to the steel alloy cannot get to it.

Nylon

Nylon slings have many advantages over chain or wire rope. They are kink free, non-spinning, much lighter in weight, fast to hook and unhook and not as abrasive to the load. The most common designs are the eye and eye type and the endless. Either of which can be ordered with a variety of hooks or other hardware to suit the users needs.

All nylon slings come with an identification tag which shows the rated capacity, length, serial number and the name of the manufacturer. If the tag is missing the sling should not be used.

A visual inspection of the sling has to be made periodically to ensure structural integrity. Look for broken stitching (especially around the eye areas), caustic burns, melting or charring due to close proximity of an external heat source, snags, punctures, tears, cuts, distortion of fittings and wear of the fabric at any location. If any of these defects are found, the sling should be taken out of service. Measurement of the sling is always a good way of checking for structural damage. The tag placed by the manufacturer indicates the original length. If the sling is longer than what the tag indicates, damage has occurred.

Some slings have a red-guard wear warning. This webbing has inner load-bearing yarns that carry over 80 percent of the load. The red yarns are woven into the inner layer, and are exposed when the protective outer cover layer is worn away and/or damaged providing a visible warning. This simplifies inspection. Exposure of the red yarn warns that the sling should be replaced.

A treatment of neoprene or polyurethane is provided for better handling and a longer life. The neoprene increases resistance to wear and provides a firm gripping action on the load. It also increases penetration resistance. Polyurethane will greatly increase the sling life and gripping action and also helps to reduce abrasion of fragile loads by the surface of the webbing. It, like neoprene, also increases penetration resistance.

Option wear protection for these slings is also available. These pads are sewn to the webbing at wear points. Multiple layers are available upon request. Edge guards are also available. As you can guess, these are sewn along the edges wherever protection is required. You can have a sleeve pad installed, which protects both sides and the edges and can be placed wherever required, since they are not sewn to the sling.

A nylon sling, like a wire rope sling or chain sling, should be hung up in a dry area, away from acidic or caustic vapor. Again, if on the floor, other material could be stacked on it, or it could be run over by equipment, causing deformation. Never leave a nylon web exposed to sunlight for any length of time. Ultra-violet has a tendency to break down the nylon.

Personnel and Safety

Many manuals are available for crane and rigging procedures. A combination of class training and field training is a must. The hands-on training by an experienced rigger and field experience always tells. The person doing the rigging should be familiar with the equipment and material that he or she is working with. Riggers are not born, they are well trained individuals with years of experience.

In many cases, the rigger will be his own designer. That is why classroom training is necessary. On the job, he will analyze the situation, make the necessary field measurements and ascertain the proper material requirements. He will inspect all the components of the rigging and crane.

The rigger will look at the physical characteristics of the lift. He will decide whether or not he has the proper clearance; no one wants a boom in an overhead high tension line. Some picks are like threading a needle, you have a very limited space in which to work. He will also check to see that he has a good foundation for the crane to sit on.

The handling of the slings is very important. A rigger will not use frozen rope, will not allow shock loads (the sudden take up of slack), will protect the sling from sharp edges by using a cushion, avoid dragging slings from under loads or over obstacles, avoid dropping the sling from heights and will never pick a load where the conditions are so severe that there is hazard to personnel or to the load that is being picked.

The rigger is aware of the physical characteristics of his slings and the properties of each. He knows in any given circumstance what the sling will do. Each hookup is studied. He knows exactly how a hook has to be placed so that a twisting motion or kink will not occur. Rigging is a science and does have to be studied. You have to know what you are doing at all times.

You also have to know what each individual is doing. To accomplish this, explain to everybody exactly what their function is prior to a pick. A thorough understanding has to be reached. This can be one of the biggest causes of mishaps. If an individual is not aware of his responsibility and/or function, there is a failure on the rigger's part to do his job. You cannot afford to have any misunderstandings. Life, limb (the two most important) and property are on the line.

Conclusion

We have attempted to go over a lot of data and feel we have hit on the high points. There is a lot of information available through various sources on this topic. The information covered here today is essential for a qualified rigger. (Applause)

Mr. Walbrun: Thank you for that most informative report. Our next speaker is Gary Brockington with the Wisconsin Department of Transportation, located in Green Bay, Wisconsin. The presentation is on the Tayco Street bridge collapse that occurred in Menasha, Wisconsin. Gary is a graduate from Michigan Technical University in 1964 with a Bachelor of Science in civil engineering. He has worked for Wisconsin DOT since graduation, primarily in the design, construction and maintenance of the state's highways and bridges. Gary is here to present a story of a rather surprising bridge problem. This problem can be traced back to the original design of the bridge which is almost 60 years old.

TAYCO STREET BASCULE BRIDGE COLLAPSE AND REPAIR

Gary Brockington
Wisconsin Department of Transportation

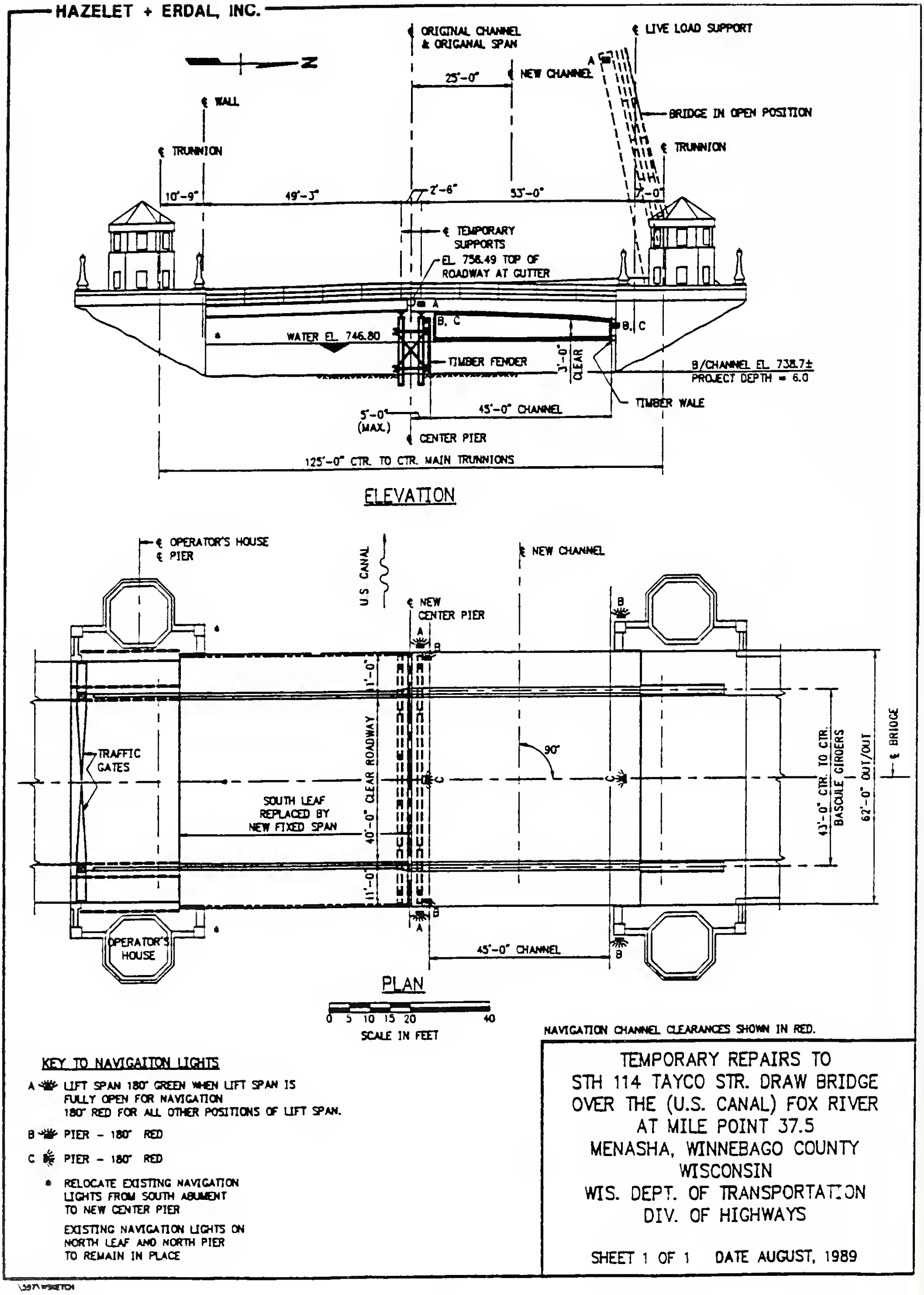
Background History

The bridge is a double leaf Strauss Trunnion bascule constructed in 1928. It is located in the city of Menasha, Wisconsin, and carries STH 114 (Tayco Street) over a United States government canal. The canal is a link in the Fox River Lock and Dam System between Lake Winnebago near Oskosh and the bay of Green Bay. It is a series of locks and canals and dams there. There are actually 17 locks that take Lake Winnebago down to the level of Green Bay, which is the same level of Lake Michigan. The bridge is a thru girder structure with a 40 foot clear roadway and eight foot sidewalks cantilevered on each side for an overall width of 62 feet. It was 125 feet between main trunnions with a 100 foot clear channel. There is five feet of clearances at mid span. Mainly pleasure craft use the lock system. There is an average of 2,000 openings during the six month navigation system.

Chronology of Events

At 3:00 p.m. on Saturday, June 24, 1989, the south leaf collapsed and fell into the canal. There had been 17 openings that day between 8:45 a.m. and 3:00 p.m. The cause of the collapse was due to seizing up of the main pin supporting the hanging counterweight resulting in the counterweight falling off the main trunnion girder. This happened as the bridge was above half way open.

This bridge has what we call a hanging counterweight on the back of it. There is a pin connection hanging on each side of the two main girders with two plates supporting the big



KEY TO NAVIGAITON LIGHTS

A LIFT SPAN 180° GREEN WHEN LIFT SPAN IS FULLY OPEN FOR NAVIGATION
180° RED FOR ALL OTHER POSITIONS OF LIFT SPAN.

B PIER – 180° RED

C PIER – 180° RED

- RELOCATE EXISTING NAVIGATION LIGHTS FROM SOUTH ABUMENT TO NEW CENTER PIER

EXISTING NAVIGATION LIGHTS ON NORTH LEAF AND NORTH PIER TO REMAIN IN PLACE

TEMPORARY REPAIRS TO
STH 114 TAYCO STR. DRAW BRIDGE
OVER THE (U.S. CANAL) FOX RIVER
AT MILE POINT 37.5
MENASHA, WINNEBAGO COUNTY
WISCONSIN
WIS. DEPT. OF TRANSPORTATION
DIV. OF HIGHWAYS

SHEET 1 OF 1 DATE AUGUST, 1989

hanging counterweight. The counterweight is down underneath the road. The only reason we can figure out for the hanging counterweight was just to save room in these pits. There is a restricted area here with railroads close by and you are keyed into bedrock so there's not much room. So that's what we call a hanging counterweight. There are only one or two left in the state of Wisconsin. Most of our counterweights are poured solid right into the end of the girder. The only way they can fall out is if the girder itself is ripped in half. The cause of this collapse was the seizing up of the main pins supporting the hanging counterweight resulting in the counterweight actually falling off the main trunnion girders down into the pit. As a result, the portion over the canal just collapsed right into it. The way we have it now is this north side is all blocked up and cabled off. Otherwise, what holds the bridge in the open position is strictly the motor brakes and the trap brakes. In this particular case we were worried that the counterweight might fall so we put hardwood blocks in the gears and off the back of that particular leaf to hold it open.

On Monday, June 26, the State of Wisconsin engaged the firm of Hazelet and Erdal, Incorporated, to investigate the reason for failure and solutions for temporary repairs. We felt it was best to bring in an outside agency with no particular ties to us to determine what caused this failure.

On July 12 Hazelet and Erdal submitted a report to the Wisconsin Department of Transportation listing four options for repair. Basically there were only two: one was to build a temporary span where this one had fallen in, and the other was to make permanent repairs and fix everything that did fall in.

Hazelet and Erdal also stated that the cause of the failure was unique to the south leaf. They found out that the hanger pins from the counterweight did not have full bearing from the beginning. The grease could not get through to the back side. The pin itself was supposed to have a keyway in it so a plate would hold in it. It was a physical restraint. Instead of that keyway, the pin itself was notched. So in a sense all you had was the counterweight hanging there by gravity. These were some construction errors that were put in that have been there for sixty years. These errors chose that particular moment to seize up partway open as the relative stress the counterweight fell in.

A couple of days later we decided to go with what they called option number four and that was to replace the collapsed section with a temporary span. On July 21 We sent out a letter to four area contractors from the State that had the ability to do this type of work. On July 27 we selected Lunda Construction Company of Black River Falls, Wisconsin, to do the repairs on a time and material basis.

On July 31 we held a meeting in Madison, Wisconsin, between Lunda, Hazelet and Erdal, and the Wisconsin DOT. The exact method of temporary repairs plus hours of work were agreed upon. At the same time the meeting was in progress, Lunda was setting up a 150 ton crane at the site and starting to cut up the collapsed leaf. The local power company started relocating their main power lines to a paper mill which was over the south abutment and by August 3 all the power lines were relocated.

Following are a series of slides that begins with removal of the old bridge and construction of the permanent temporary span.

This is the shaft that the trunnion was hanging from and that it slid out of. This the pin laying down there. You can see a grease groove right here. This pin is about two feet long and ten inches in diameter and made of solid steel. There were three grease grooves that were supposed to take the grease all the way through to the other side. They found out that in these areas right here that the grease was not going all the way through to the hidden back side. It was just coming in and running right down the plate.

This is the one that really failed and is still in there. This one didn't come out and was the one that failed first. You can see there was supposed to have been a groove right here. You can see how it was notched straight on out. This is the bearing area right here that the hanger plates hang on. There should have been a notch right here and you can see there is nothing there. These plates were just hanging on there and there is hardly any lubrication over on this side. The grease from the far side did not get through. This is the plate where it was bent out. If this plate had been in the groove instead of being able to move, the pin would not have slid. This is the keeper plate that was supposed to have been in a groove in that pin.

This shows some of Lunda's men trying to remove that steel grid. They couldn't get in because of the overhead lines but they were taking out portions and cutting up this steel grid.

This shows the four beams here that go between the two main girders and these are all the stringers that support the steel grid. This shows the impact of that bottom flange which is about four inches thick when it hit that concrete and put a pretty good dent in it.

One of the options was to take these two main beams and make a fixed span out of it and pour a concrete deck and salvage it. We were a little leary of that because we didn't know the condition of these things as they were under the water. As it turned out we made a good decision. Lunda had some scrap beams from a bridge they had salvaged and rather than reuse any of this material we decided to bring in the scrap beams since it would be a lot quicker to do it that way.

With a trunnion type bridge you need some kind of a physical restraint out in the middle and this is the center lock portion. It was a pin and hanger type arrangement that would lock one leaf to the other when the bridge was in a down position.

This is the portion that is over all the machinery and the counterweight is underneath here. This was a fixed type portion that did not open.

We had to remove a portion of this front wall in order to pour a cap on it. This is the portion where the new beams are going to go in this direction so they had to do some remodeling to this portion to accommodate it.

We decided to build a bent type pier out in the middle of the canal considering we had some piling that was driven down into bedrock. At the time all the dismantling was going on, Lunda was making the pier cap type arrangements over in his yard in Black River Falls. We decided to use this method because we could do all this work and make it out of steel ahead of time while we were removing the old bridge. If we went with a concrete pier or something like that we would have to wait on all that forming. This way, the day they were out of the way we could start erecting this thing.

This is what we call a shoe pile. These are H-beams. We only have about 15 feet from the water down to bedrock, solid limestone, so we wouldn't have had much stability because there's hardly any dirt. So we wanted to sink these pilings into the limestone so you have this real hard pile shoot that goes under the end and that allows you to drive this piling down into bedrock.

This is a secondary type pier cap because the girders that we were leaving in position from the bascule span, the two main girders, are a lot deeper than these temporary girders that we brought in so we had to make a little step in this pier.

Here is the pier in place with the secondary step and we are starting to bring in these girders.

On September 13, the project was completed. The total cost of repairs was approximately $245,000 for construction and $55,000 for related engineering services including the Hazelet and Erdal investigation.

A new 48 foot clear single leaf rolling girder bascule bridge is being designed by Hazelet and Erdal and is scheduled for letting. The approximate cost is $3,000,000. Well, that's it. Thank you for your attention. (Applause)

Mr. Walbrun: Thank you very much, Gary, for a fascinating presentation. It's not often that a problem 60 years old comes back to bite you in the butt.

George Willis is a 30 year veteran of Factory Mutual Insurance. Factory Mutual is the railroad insurance company for the physical plants of many railroads. He spent the last seven years before his retirement in 1988 as the district chief engineer. He is now working as a private consultant for Factory Mutual. George is a registered professional engineer in Pennsylvania and spent a large portion of his life looking at fire and the results of fire. I think we have a very informative presentation ahead of us. George.

FIRE CONCERNS IN RENOVATED BUILDINGS

George Willis

Factory Mutual Insurance Company

Thank you, Mark. Good afternoon. The subject is Fire Concerns in Renovated Buildings. I think the title seems to indicate past tense and what I would like to do is cover the entire process. There are three points to remember when you want to renovate or conduct any kind of renovations and that's before, during, and after.

Before the renovation you want to do is the most careful planning that you can do. You have an idea and you want to look over all the aspects of what you want to do to make sure you have covered all your bases. If you don't do that you are going to fly by the seat of your pants and get into trouble.

During the renovation you want to take normal precautions. It's just common sense: smoking, cutting and welding, trash removal, that's just a few of them.

After, if you have planed everything and taken the proper precautions you are going to end up with a successful renovation. No problems and you will get what you want.

There are three ingredients that I usually look at when I get in any kind of construction renovations or anything of that nature. They are all interrelated and I don't think you can take any of them out. They are: construction, occupancy, and protection. They are all sort of one subject, so intertwined you can't divorce them.

When you think of occupancy you want to make a change because you have a building, a product, or an operation which you want to change, maybe make a new one, maybe an expansion, maybe a relocation. There are any number of things that you can do.

First of all I just want to cover a few of these things. Obviously I can't cover them all but I want to cover the ones that I think will cause the most trouble.

Storage

I'm sure everyone has storage. There are three types of storage. You have pallet, on-floor, and rack storage. You may want to change from pallet to rack, from rack to on-floor, or you may want a combination of the two. That will make a big difference in your sprinkler protection. One, you don't need so much wood or others, you need more wood and so forth. You may want to change your products. You may go from a combustible to a non-combustible or a combination of any of the two. You may want to introduce oils, anti-freeze, plastics, any of those products and you are going to introduce an additional hazard which you are going to have to compensate for when you decide what protection you are going to use. You get into flammable liquids, solvents, you get your bad acids, your acetones, your MEKs. Obviously, you don't want to put those in the center of a building. You want to put them in a corner and protect them. If you put them in the center of the building you are introducing a bomb which is only going to come to grief later on.

Then you get into manufacturing or, in the railroad industry it's probably more car repair buildings. In passenger cars you have plastic seats and all kinds of combustibles which you use to refurbish it. They'll have to be in the area. That's a problem to look at.

You may have hydraulic operations. You may have a 200 or 300 gallon reservoir of hydraulic oil and if you get a pinpoint in that line and it starts leaking and you're not protected, it's just like a blow torch. You aren't going to stop it.

You may want to renovate your office. There again, we look at offices and think they're not much of a problem. There's not much there that will burn; but is there? Some of these offices you go from the old spartan offices into the more plush type and your furniture can be combustible. Computer terminals are combustible. There is a lot of plastic in computers and they all burn. You have engineering offices that consist of extensive files and plans. That's another aspect to look at.

Next you get into construction. There are all kinds of buildings, multi-story, one story, combinations, combustible, non-combustible and you have to take all of these things into consideration. In addition, you have your vertical and horizontal cutoffs, your fire doors. You want to hold that integrity. I remember a case once where a renovation was made. It was a one story building split in several places with walls. One wall was a sliding fire door. For some reason, the installer left an inch space between the door frame and the wall on the top. One day a fire broke out and the sprinklers were taking care of it. However, the fire found its way through that opening and got into the other space. Here again, when it got through and started burning it found another problem. Some of the sprinklers had been blocked. It was a dry system and rust had gotten into the heads and what you ended up with was a major fire. If that fire door had been properly installed and had been sealed up, it would have been minor.

In your utility work, there are piping chases, wire chases, curtain walls. Those all should be sealed to make sure that if you get a problem on one floor it doesn't propagate to the other floor.

Last is protection. Depending on the construction and degree of combustibilities for your occupancy, the objects you have, you have to consider adequate protection. Maybe the building is sprinklered, maybe it isn't sprinklered; maybe you want a sprinkler. But one thing to look at is if the building is sprinklered and you change from one type of operation to another, you want to analyze them and see what they are actually good for because they may not be enough to do the job. You may not have enough water supplies but you may, you could conceivably put in some storage, be it a pump and tank or a booster pump, fire pump. So you have to look at all of these things in advance and make sure that you have analyzed it. Just because sprinklers are there doesn't mean they are going to do the job if they are not compatible with your storage. There are a lot of misconceptions with sprinklers. When you design a sprinkler system you design it on a maybe a 2,000, 3,000, maybe 4,000 square foot area. You have to catch it within that area. In other words, the sprinklers have to be designed properly or they are not going to work. Obviously, you couldn't have a 100,000 square foot building and expect every sprinkler to work because you would need Lake Michigan to provide enough water.

One of my favorite gripes are spot sprinklers. When you do your planning you say you are going to sprinkler only one area and save money and maybe just put 100 or a 200 square foot area when invariably that storage spreads beyond that area. It'll spread to another area, maybe the regional engineer will say he wants to do something with that and he'll put combustibles in another area. Well, this doesn't work. It's a lot cheaper to sprinkler the whole area and be safe.

At this point I have a video tape which could clear up some misconceptions on sprinklers. So if we can roll the film we'll get started. (Whereupon there was a video presentation)

Mr. Willis: To sum up quickly, the few things I've written down I've covered before, as far as spot sprinklers, it's better to do the whole building. You plan around existing construction, be careful of the integrity of the walls, door, floors, and so forth. When you consider sprinklers and water supplies, leave some fat in it. Don't engineer up to the bottom of the line. It will save you money later on. It may be a little bit more expensive now but it will be cheaper later on.

During the renovations, keep your sprinklers in service as much as you can, especially over night because all weak sections can be isolated. They can be valved and so forth but if they're in service they will be there to help you. If they're not then they can't do you much good.

That about sums it up. I have one last horror story to show you on these slides.

This is a 1,200,000 square foot warehouse. It's roughly 30 feet high and is used for storage of variety store items. You have tools, household items, food stuffs, plastic items, personal care products, oils, aerosols, just about anything. You name it, it's there. The storage was neatly situated with wide aisles 15 feet high, which is not very high. it looks rather innocuous. The building was separated into four quadrants. The walls were designed to stand if there was a fire in any one quadrant. If you had a fire you would burn out the one quadrant and that's all you should do. That would be the worst scenario. Well, back when this was built, instead of installing fire doors they installed water curtains at the doors on the premise that a fire would be prohibited from going from one area to another due to that curtain of water there. That was all right for a while but there one or two things they didn't count on, aerosols. Aerosols change the fluorocarbons to the flammable propellants. When that happened nobody evidently had thought about it. So one day, I'd say around 12:00 or 12:30 p.m., there was a lift truck driver with a case of aerosols on a pallet and evidently one dropped on the floor. The lift truck ran over it. The truck was electric and a spark from the truck ignited it and it started and before anybody could do much about it, it was beyond the help of the fire brigade. So the fire department had to be called. Now this fire started around 12:30 p.m. This is the shot at 1:00. It had the one quadrant where it started completely involved. Here's another shot at 1:15. Here at 1:40 it's just gaining headway. At 1:45 it just about totally involved. You see how fast it spread. These next shots are around 2:00 in the afternoon and what happened is that these aerosols rocketed right through this water curtain. Had there been doors there it probably would have stopped it but they started rocketing and once it started there was nothing to stop it. In fact they found an aerosol can on a building a mile away from this fire.

This series was taken at 8:30 at night. That incidentally was the area where it started. Here are some of the shots the day after and this is what's left of the building. It burned for at least two days after and the second day you could still hear the aerosol cans popping off. If you can remember the original diagram, this is what's left and it's not much.

The point that I would like to make is renovations not only take the form of something that you plan and do but they can also take the form of a case like this where a technology advanced faster than the protection that was supposed to take care of it. I think that is one thing you have to be careful of. You have to keep up with what you have. You can't go to sleep and say what I have today is going to work tomorrow. Thank you, that's all I have for now. (Applause)

Mr. Walbrun: Thank you, George. That's kind of a sobering thought for those of us who have aerosol paint cans in our locomotive houses.

Our final presentation this afternoon will be introduced by Doug DeBerg. Doug.

Mr. DeBerg: Thank you, Mark. It is my pleasure to introduce the next speaker on the program for this afternoon's session. The subject is the Conversion of Open Deck to Ballast Deck Bridges. Mr. Jimmy Neece, the chairman of this subject, is a supervisor of B&B for the Mobile Division for the CSX Transportation Company. Jimmy received his BS in civil engineering from Tennessee Tech University at Cookeville, Tennessee. Jimmy began his railroad career with the former L&N Railroad in 1973 in their student engineering program. In 1978 he began working full time in the bridge design office in Louisville, Kentucky. From there he progressed to assistant B&B supervisor in Louisville, to bridge inspector in Nashville, to resident engineer of structures in Jacksonville, and from there to his present position. At this time I would like to present Jimmy Neece.

SPECIAL SUBJECT NO. 2

Conversion of Deck Bridges to Ballast Deck Bridges

Chairman: J. L. Neece, B&B Supv., CSX, Helena AL

Committee: K. Jennison, Dsgn.Engr., BN, Englewood CO
M. Johnson, Dir.Br.Engrg., BN, Overland Park KS
A. S. Uppal, Mgr.Br.& Strs., CN, Edmonton ALB
R. Cacchiotti, CN, Montreal QUE
C. W. Young, Proj.Engr., Conrail, Dearborn MI
J. J. Helm, Strl.Engr., Teng & Associates, Chicago IL
D. Franz, Br. Engr., KCS, Kansas City MO
C. M. Russell, Asst.DE-Bridges, NS, Decatur IL
W. S. Riehl, Civil Engr., Seminole Gulf, Ft. Myers FL
H. B. Matthews, Br.Insp./Supv., Port Authority of Allegheny County Transit, Pittsburgh PA
D. R. Ladner, Engr.of Dsgn., WC Ltd., Rosemont IL
T. D. Eorgan, Sr.Sls.Engr., Carlisle Syntec, Carlisle PA
R. Sheets, Pres., Sheets Masonry, Elkview WV
D. E. Bartholomew, Sr.Proj.Engr.RR Fac., Sverdrup Corp., Bellevue WA

Introduction

Special subject No. 2, ''Conversion of Open Deck Bridges to Ballast Deck Bridges'', is an extremely important alternative for any major Class I railroad to consider today. Increasing emphasis on economics and reductions in manpower have resulted in railroads looking at alternatives that were previously not considered.

There are many alternatives that can be chosen such as:

1. Replacing an open deck timber pile trestle with pre-stressed concrete slabs.
2. Replacing an open deck through girder bridge with new steel girders and a steel deck.
3. Converting an existing open deck timber pile trestle bridge to ballast deck by adding additional stringers and adding the deck boards.

As you can see, these alternatives are more of a rebuilding solution. This report will investigate alternatives without having to replace the substructure or superstructure.

Before a conversion is undertaken a quality engineering study should be performed consistent with any bridge project. Items such as criteria, design and economics are the major areas to be identified and investigated.

Criteria

First, there should be a need for conversion. The existing open deck ties should warrant replacement. Once this criteria is met, other factors such as alignment, grade, available clearances, condition of substructure, tonnage, remoteness and susceptibility to fire should be taken into account. The effects of surrounding facilities such as road crossings and switches due to a grade rise, E-rating, and whether the bridge is over a roadway and could cause damage to vehicular traffic because of the open deck must also be considered.

Generally, the annual gross tonnage has some bearing on the decision-making process. Some railroads will not consider any line with less than five million gross tons, while others have a minimum of 15 million gross tons.

The type of structure also has to be considered. Generally, through trusses, due to the overhead clearance and open deck timber trestles, and because of the possibility of having to add additional stringers and replacing piling and caps, are not considered. Some beam span structures are not considered because it is more economical to replace the spans with a prestressed concrete slab and use the steel beams to upgrade branch line bridges. The criteria considered most important by railroads is the load carrying capacity of the bridge, Cooper's E-rating. By converting an open deck bridge to a ballast deck bridge the dead load is increased, thereby reducing the load carrying capacity. Generally, the minimum E-rating allowed is E-60, based on the AREA's rating criteria.

TYPES OF DESIGN

Steel Plates

The use of steel plates one-half inch to one inch thick or thicker, as specified by the design engineer, are fastened to deck plate girders, rolled beams or stringers. These plates, 12 to 14 feet wide, are fastened by the use of one inch diameter high strength bolts or field welded. The ballast curbs or ballast retainers are 15 to 18 inch channels welded to the edge of the steel plates.

To waterproof these decks several different products are used. These products are one-half inch thick asphaltic planking, rolled roofing or a bitumenastic. PVC pipes are also installed to aid in the drainage.

The installation of this type of deck requires some extensive preliminary planning:

1. Ballast pans must be delivered to job site and checked for workmanship and correct measurement.
2. Track must be paneled.
3. General maintenance work must be completed. This may include repairing bearing areas, masonry repairs to back walls, piers and abutments. There may also be some steel repairs needed.
4. Curfew set up. A curfew is an agreed upon time frame between the maintenance-of-way department and the transportation department and will ensure the track is free of traffic.

The actual installation will require a crane capable of handling the ballast pans and also the track panels. The average size of the B&B gang needed for this installation is five men, a foreman and the crane operator. The track department would aid in the ballast placement and the surfacing.

Timber

The use of creosote timber as deck boards, mostly southern yellow pine, is a highly used method of conversion. The thickness of deck boards depends on the center to center distances of the girders. For example, a six foot six inch center to center girder distance would require a deck board six inches thick at center line of track. A nine foot center to center girder distance would require an eight and one-half inch thick deck board at the center line of track.

The deck boards are 12 inches wide by 12 to 14 feet in length, depending on whether a walkway is required. The 14 foot width boards are placed every fourth board for the walkway grating to rest on. The deck boards are placed directly on the top of the girders, perpendicular to them. Every fourth deck board is hook bolted to the bottom of the top flange of the girder. The boards that the hook bolts go through are counter sunk in order for the nut and washer to fit below the top of the board.

The ballast curbs, 8 inches by 14 inches by 16 feet long, are installed at the edge of the 12 foot deck boards. Some railroads install a two inch thick by 14 inch wide by 12 inch long drain block under the ballast curbs. Others have the ballast curbs dapped to these dimensions to allow the deck to drain.

Waterproofing the deck is accomplished with the use of six mil polyethylene sheet installed on top of the deck boards, then a layer of .120 inch thick butyl rubber membranes is applied. On top of the rubber, two layers of one-half inch thick vibraflex boards are installed.

The installation of this type of conversion can be performed as panels or by installing the boards individually. The installation of panels is very similar to that of the ballast pans. The equipment and track curfew would be the same. The second method of installation would be by installing each board individually. To do this, the B&B gang would need a tie handler/bridge tie crane, plus general B&B tools. The tie handler would install the individual boards between trains and the B&B gang would also make the necessary run off, therefore, no curfew would be needed. Upon completing the installation of the deck boards, ballast curbs and waterproofing; a T&S (track and surfacing) gang would install the track ties and ballast.

Economics

The conversion to ballast deck bridge is initially more expensive. Actual dollar costs per lineal foot of ballast deck bridge ranges from $300 to $450 per lineal track foot. The average cost of open deck bridge ranges from $150 to $250 per lineal track foot. Both costs are dependent upon the amount of track time available during installation. The actual dollar cost is not the only factor to consider when discussing economics. Theoretically, the ballast timber deck installation will have an average life of 25 to 30 years, twice that of an open deck bridge, thus reducing future repair or replacement expenses.

Conclusion

There are many pros and cons to converting an open deck bridge to ballast deck. With the limited amount of man power and track time available, the advantages of a ballast deck bridge greatly outweigh the disadvantages.

Some of the major advantages are:

1. Maintenance associated with low approaches would be eliminated.
2. Maintenance of ties, alignment and surfaces would become the responsibility of the track department.
3. Raising piece would be eliminated.
4. Possible steel damage due to derailments would be eliminated.

It should be pointed out that a contributor from a northern railroad indicated that excessive freezing and thawing in their northern climates greatly reduced the advantages of conversion. However, with a good drainage system and good waterproofing, the ballast deck bridge should give a very low maintenance structure in any region. Thank you. Anyone have any questions at this time?

Mr. Mitchell: At the very opening you had some slides showing the conversion utilizing welded rail with stringers and that conversion process looked to me like it would be something that would take much more time than just an ordinary window that the transportation department would give. How long does such a project like that take? What sort of window was necessary?

Mr. Neece: I'll let the contributor answer that one.

President Burns: In that case we were doing about five panels in about six hours. It takes the right territory where you can use the long rails, otherwise you might want to piece them in. We have been known to do about an eight panel bridge in about eight hours.

Mr. Neece: Any other questions? Thank you. (Applause)

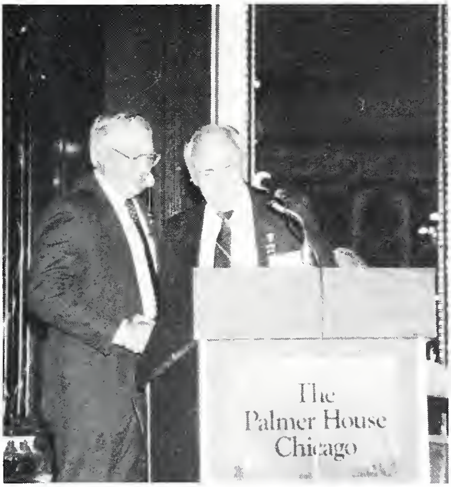
President Burns: Thank you, Mr. Neece. Before we adjourn for the day I would like to remind those of you who have not already done so, to please fill out one of the special subject cards for 1991 and turn it in at the registration desk. We will meet at 8:30 tomorrow morning in joint session with the Roadmasters in the Red Lacquer Room. Today's session stands adjourned.

Adjourn

TUESDAY MORNING JOINT SESSION

September 18, 1990

President Pottorff: The second joint session of the Roadmasters and Maintenance of Way Association of America and the American Railway Bridge and Building Association will now come to order. At this time I would like to call Karl Sutherland to the rostrum. Karl is a past president of the Roadmasters and Maintenance of Way Association and retired director of maintenance for CP Rail. Karl.



H.G. Webb & K.W. Sutherland

Mr. Sutherland: Thank you, President Pottorff. Ladies and gentlemen, at this time I think it would be appropriate to recognize one of the outstanding supporters of the Roadmasters and Bridge and Building Associations, Herb Webb. As you know, Herb just recently retired as vice president and chief engineer of the Santa Fe and served many years in the rail industry. He is well known throughout the United States, Canada, Mexico and abroad. During his years with the Roadmasters he served on the board and I had the pleasure of serving on the board with him. He joined the Roadmasters in 1963. He is also a member of the Bridge and Building Association and a past president of AREA. Herb has always been willing to give his support and participation on committees for reports like those being presented at this conference. Herb, will you join me here please? Herb, on behalf of the Roadmasters and Maintenance of Way Association, the Bridge and Building Association and all your friends here today, may I extend to you our sincere thanks for your help to all of us over the years. Also again, on behalf of all, I wish you and your wife, Marilyn, many years of good health and happiness in your retirement. Can we have a nice big round of applause? (Applause and standing ovation)

President Pottorff: Thank you, Karl. Ladies and gentlemen, members and guests, on behalf of the Roadmasters and Maintenance of Way Association of America and the American Railway Bridge and Building Association, I welcome you to the second joint session of this conference here in Chicago. The registration this morning is 164 Roadmasters; 90 B&B; 302 Associates, 84 ladies, for a grand total of 640. At this time, it is my pleasure to introduce Mr. Roger Engle, assistant chief engineer of the Atchison, Topeka and Santa Fe Railway. Roger was born in El Dorado, Kansas, on November 10, 1945. He graduated from Northern Arizona University in 1973 with a B.S. in civil engineering. Roger began his career with the Santa Fe as a chainman in Winslow, Arizona, in 1972, and had the positions of rodman, roadway assistant, assistant roadmaster, roadmaster, assistant division engineer, division engineer, regional engineer, and district engineer until he was promoted to assistant chief engineer-maintenance in August, 1989. Roger.

KEYNOTE ADDRESS

Roger Engle

Assistant Chief Engineer-Maintenance
Atchison, Topeka and Santa Fe Railway

Roger Engle

Thank you, Keith. As you heard, had it not been for circumstances, you would be listening to Herb Webb today instead of me. Herb, who had been asked to do this, felt that an active railroader ought to give this talk so I'd like to begin by saying I am honored that Keith asked me to replace Herb on the program.

When I asked Keith what the subject of the talk was to be he said that it was basically the state of the railroads as I saw them. Well, I thought that was a fertile field. You could look around and see a railroad in just about any state you want to. I'd like to tell a story about a railroad which will remain nameless but does illustrate what can happen and probably has happened to many of you in your companies. Once, there was this average size railroad that was doing rather well, but decided it could do better if it had a partner. So it went out shopping for a bride to fill the bill. It didn't take long to find what it thought was a perfect match. Well, as you know, there is more to railroad combinations than just finding a willing partner and a justice of the peace. You have to submit your request to the grand potentate of the railroad marriages, the Interstate Commerce Commission, which must bless the sanctity of such activities. As luck would have it, there were problems in the respective bloodlines of these two railroads and they were unable to join and live happily ever after.

Having been jilted, this average-sized railroad was making plans for continued survival but, I must admit, felt a little miffed and somewhat unattractive. So what could be done to become more attractive? Perhaps, it had gained weight over the years and maybe it should cut down, trim up a little, become lean and mean. Perhaps it should reorganize, get rid of excess baggage. This can take the form of employee reductions, elimination of non-profit branch lines, or a combination of the two. Once you know what to do, decide exactly how you should go about it.

First you could use a scalpel and do some trimming but sometimes that is too slow. Second, you could use a butcher knife, but that could be painful and some folks think that is too slow. The way found to be most acceptable to achieve the biggest and quickest is to use a meat cleaver, sever as much as possible at one time, and change your company's image. This is the approach that is professed by the MBAs and the consultants that are so prevalent in our industry, as well as other industries, today. Jim Miller, our recently retired assistant chief engineer here in Chicago, once gave a definition of a consultant that I thought was appropriate. The consultant is the guy who can tell you 200 different ways to have sex but he doesn't have a girlfriend. (Laughter) These guys can think of more ways to write off, write down and spin off companies than a normal guy can ever imagine.

This average-sized railroad that I have been talking about has gone through a majority of these exercises and there may be more adventures for it in the future. But I'm sure nearly all of you here could tell a similar story about your companies. Without exception, every railroad has gone through changes that has disrupted your jobs, your territories and your piece of mind. Mergers, reorganizations, and the like are disturbing. The fact that others are going through the same thing on their railroads really never gave me much comfort. I don't like to sound calloused, but I didn't much care what others were going through when my road was being turned upside down.

Now that I have told you all the bad things that have happened and that are still happening to almost all of us all in our railroad lives, I would like to tell you to forget it or put it out of your mind; put it behind you. You can't function in an effective way if you are dwelling on the misfortune that you think has befallen you. There is nothing you or I can do about corporate decisions regarding your company unless you are a major stockholder and are just working for a hobby. The best thing that you and I can do is concentrate on what we know best, which is maintaining an efficient physical plant to enable our companies to run trains as profitably as they can. We don't have time to sit around and wait to see what is going to happen next. We must actively pursue the maintenance of our railroads to the extent possible within the means available to each of us.

I think we need to refocus on what we do. Everyone here has the position they hold because they have demonstrated the management and leadership as well as the technical skills necessary to do the job of maintaining track and bridges. The fact that your company has sent you here to participate in this conference further demonstrates the fact that they believe this to be true. Again, if we are spending time worrying about what the board of directors is doing, we are not taking care of our business of maintaining a quality physical plant. I don't mean to imply or to mislead you to think that you should not be concerned with how your company is doing in the financial world or the direction it is going. Certainly you should be concerned. You have a vested interest in the future of your company. But the thing you can do to assure some measure of profitability is make sure you do your job as efficiently as you can. And I don't think we can do this if we spend a lot of time dwelling or speculating on what the corporate leaders of our companies are doing. I firmly believe that we need to get back to basic railroading in order to insure the survival of our companies.

If your company is like mine, we decided a long time ago that the large non-headquartered gangs do the major maintenance projects. We have large 100 man plus steel gangs, mechanized tie gangs. We have specialty gangs that work on such things as road crossings and curve relays. This has proven in the past to be the most cost effective way to maintain our railroads. These big gangs have the manpower and have all the big fancy machines. However, in doing this we have fostered the mentality among our headquarters section gangs that there is a difference between what they do and the work that is to be done by the extra or non-headquartered gangs. Our sections, I believe, have come to think of themselves as firemen. They stay in the firehouse, polish their truck, and wait for the next fire to be ready to respond. There is no doubt that they are much like firemen, we depend on them to handle emergencies but I think most of us who have adopted the extra-gang philosophy would tend to minimize the importance of sections. They are the mainstay of our railroads. Aside from handling emergency situations, I think they should be used for program-type maintenance as well. Couldn't they be scheduled to do some road crossing or curve renewal work as well as many other jobs along with emergency functions? I think so. We need to get back to the basics.

Speaking of the Santa Fe, and I am sure most of us here are in the same position to some degree or another, money is very tight. We are constantly asked to make reductions, cut back on personnel projects or both. With capital expenditures for track and bridge maintenance being upwards of 50 percent of the capital dollars spent on the railroad, it is no wonder that we are always asked if we can reduce. Because it is so expensive to maintain a physical plant of a railroad, you need to make sure you spend the money wisely. There is a wine company that has the slogan, "It will serve no wine before its time". Aging may be an attribute to wine but aging measured in million gross tons is a detriment to our track and structures. I would suggest the idea is sound; we should not change our tie or rail or surface track or renew a bridge before its time. The life of our various track and bridge components have a somewhat predictable life but it is nothing more than a prediction. We need experts in the field making the decisions day to day to determine when the useful life of components has been exhausted. Under the best of circumstances it costs a lot of money to maintain quality track and structures, but without quality field people making sound decisions about cost effective repair work our costs would increase significantly.

How can we assure ourselves of having quality field people? We need to concentrate on education and structure training. Most of us relied upon on-the-job training and osmosis to develop our field supervision. Certainly there is no substitute for field experience, but it is not enough. We must continue to support the foreman as well as roadmaster's and bridge supervisor's classroom type training. Failing to do this puts these young potential leaders in situations they are not equipped to handle and the results can be expensive and also disastrous.

I mentioned earlier the large extra gang with big highly productive machinery. This has proved to be a cost effective way to approach major maintenance work, but it is not always the best or the only way to approach the problem. On the Santa Fe we are looking at a concept of alternative track maintenance methods. Notice I did not say an alternative to track maintenance. There is no substitute for track or structures maintenance, but there are a variety of methods that can be used to achieve our maintenance goals.

I know that we are not unique and others are looking at a similar program but let me explain how we view the problem and a possible solution. To illustrate I'll use the tie gang as an example. Today, we use a 34-man gang that has a consist of 50 machines that are built for speed in doing their particular task. The whole operation is very efficient. As a rule we can change 300 ties in a productive hour. We have changed over 3,000 ties in a ten hour day and that's all the good news. The bad news is that these machines are big and heavy and are not readily set off the track. Normally they are moved to a siding cleared for traffic which can take a while to do. They were not built for speed in the travel mode. These shortcomings were not really a problem until a couple of years ago. While we in the maintenance area were developing what we thought was the ultimate tie gang complement, the boys in the traffic department were making deals with a lot of big shippers to move their commodities in a much more expeditious manner. I said earlier that even though you shouldn't dwell on things you can't change you should know the direction your company is going. This may be a good lesson in that. But don't misunderstand. I'm not against the efforts in attracting business. After all, the railroads are not here for us to practice on to see how many and how fast we can renew the ties. They are here to see how fast and how many trains we can run to stay competitive and make money. So now we have a dilemma. Equipment that requires rather large blocks of time to work efficiently versus shipping contracts, normally with penalties, that prevent or minimize the opportunity for granting large work windows.

We have not achieved the solution but we are working towards it. Under our current practice we would not program a mechanized tie renewal until a defective tie count per mile was 900 or greater. An alternate track method to this concept would be to change out defective ties annually as they occur. That is if, under ideal conditions, your tie renewal cycle is every ten years and you renew 900 to 1,000 ties per cycle, you have approximately 100 ties become defective per year. Why not change out 100 bad ties annually with smaller less productive but off-trackable equipment? This would surely minimize train delays. It would also disturb the track to a much lesser degree thereby cutting down the need for slow orders and need for out-of-face surfacing. Sooner or later surfacing will be necessary, which will require track occupancy with large equipment; however, we feel this can be accomplished much faster as an independent operation versus behind a mechanized tie operation.

Before you ask me how this works I'll tell you. We don't know. We have done a lot of thinking and analyzing the concept but have not put it into practice. From a maintenance cost standpoint we don't think it's any less expensive than our current method. We have capital investment in the new type of equipment that many of the companies in the supply industry have developed or are in the process of designing and building now. But from an operating standpoint and the total railroad point of view it could pay big dividends through improved train performance.

Is this the only alternate way to approach tie renewal? Perhaps we should be looking at higher daily production with bigger and more machinery. As I said earlier, there is equipment available today that can replace ties at 300 per hour. Keeping in mind we want to minimize train delay, what about production of 600 ties per hour? Or twice our current capabilities? You'll still need to be occupying the track and need to have a dedicated work window, but for only half as many days. From a maintenance standpoint this is certainly more appealing than reverting back to smaller, less efficient and more labor intensive gangs. From an operating standpoint we might find them more receptive to a work window if the total days that traffic will be disrupted is 50 percent of the days that we now require.

We need to continually work on new ways to do things. The change in the tie gang approach is only one area. What I have tried to describe is a couple of ways to approach tie renewal problems. There are many other areas that need to be explored in all facets of our work. How about servicing track? Since track occupancy has become such a priceless commodity we need to find ways to make the most of what we get. We need to work on high speed surfacing. There is equipment on the market today that can surface up to half a mile of track in an hour. That was unheard of a few years ago. How about a mile an hour? Or two miles an hour? Impossible? I don't think so. If we allow ourselves to be satisfied with the production we can achieve today, we will not survive in tomorrow's market place. Because we have done it the same way for many years, does that make it right or the most economical?

Mr. Haverty, the president of Santa Fe who spoke here yesterday, has said many times that if we were railroading today the same way we did five years ago we would no longer be in business. If we plan to be railroading five years in the future the way we are today, we won't be around either.

Material quality is another area of great concern. It doesn't seem as though the life of our various track components last as long as they have in the past. I was recently out on a tie renewal project when some of the ties coming out were from the 1940s and 1950s vintage, but some of the ties being changed also had been put in in 1960 and 1970. That's a large difference in the useful life. We have had rail last well over a billion gross tons but we've also relaid rail that had barely reached 500 million gross tons. It may be that the quality of the materials have not changed but increased wheel loads have made the difference between slide. This is certainly a likely cause. But finding the cause does not solve the problem. We need to work within the railroad and supply industry to find solutions to the problem. This can be done through better engineering, better material quality and design and improving maintenance practices. It will take all of us working together to achieve success.

Those of us charged with maintaining our track and structures are known as big spenders on the Santa Fe. Probably the same is true on your railroad. It is expensive to maintain a physical plant and property to run trains efficiently, but we also have the biggest opportunity to make a difference. There is always a better way to do things and it's up to us to find them. When you begin a project you have done many times, stop and think about it a little bit. Is there a better way to do it? Because it seems routine and you are comfortable with the methods you are using does not necessarily mean it's the best or the most economical. We all need to rethink all of our practices and take the initiative to try new things.

In closing I would like to encourage all of you to be positive and enthusiastic in all that you do. There are plenty of things happening in our companies that can get us down as I talked about in the beginning; things that distract us from our jobs and break our concentration on the projects at hand. When you're up to your butt in alligators it's hard to remember your mission was to drain the swamp. But these distractions can only get you down if you let them. If you have the attitude that no matter what you do you can't make a difference I can assure you, you won't make a difference. If you are reluctant to try your ideas of change for fear of failure you will fail in a much greater sense by becoming stagnant in your job. Not every idea is a good one but every idea is worth considering. If you have a doom and gloom attitude, people will quickly adopt the same attitude and you will all be on the same downward spiral and feel that you are helpless to make a difference. Conversely, an enthusiastic attitude can make a positive difference and it, too, is infectious. It's amazing what can be done and can be accomplished with enthusiastic, motivated people. Thank you. (Applause)

President Pottorff: Thank you, Roger. We appreciate the time you took to be with us today. At this time I will turn the program over to President Burns who will introduce this morning's first special feature. Byron.

President Burns: Thank you, Keith. Our next speaker will be Mr. Lance Bordon with Modjeski and Masters. Mr. Bordon received a B.S. in electrical engineering, with a minor in physics, from Penn State in 1972. He started out as a distribution engineer with Pensylvania Power and Light Company. In 1974 he joined Modjeski and Masters as an electrical engineer. In 1979 he was made manager of the electrical section and presently supervises all electrical and mechanical activities of the firm, dealing extensively with movable bridges.

REMOTE CONTROL AND AUTOMATIC OPERATION OF MOVABLE BRIDGES

Lance V. Bordon

Modjeski and Masters

Good morning. I thank you for this privilege of addressing the joint session of the American Railway Bridge and Building Association and the Roadmasters and Maintenance of Way Association. My presentation is an overview of movable bridges that are remotely or automatically operated.

I. Existing Bridges

First, let us establish the definitions of a couple of key terms as used in this presentation:

Remote Control is when a person operates the bridge from a remote location, i.e., a location from which the waterway (and usually the bridge) cannot be viewed directly.

Automatic Operation is when the bridge control system is activated by a device detecting approaching rail traffic or marine traffic, and then operates the bridge without direct human intervention.

Variation of Remote Control:

Under the definition of Remote Control, there is currently a subtle variation worth mentioning. We will arbitrarily call it Remote Control with Guard. This is a remote control bridge with a guard present. The guard does not actually operate the bridge. He is a railroad employee, and is reportedly required by the Coast Guard for the protection of marine traffic.

Variations of Automatic Operation:

Automatic Operation can also be divided into a couple of variations or subtypes:

Automatic — Train Operated is when the bridge control system is activated by the approach of a train, usually through the track signals system.

Automatic — Crew Operated is when the train crew stops the train some distance from the bridge and lowers it from a trackside remote control panel. The bridge then automatically raises itself after the train has cleared. This could also be considered semi-automatic operation.

Example of an Automatically Operated Bridge:

An example of an automatically operated bridge is the Union Pacific's vertical lift bridge over the White River near Benzal, Arkansas.

The bridge is normally left in the fully raised position. When an approaching train is within approximately ten miles, the signals system activates the bridge controls. A marine radio begins periodic broadcasts at one minute intervals for the next ten minutes, identifying the bridge and warning that the bridge will be lowering. Each broadcast announces the minutes remaining until the bridge will close.

At the same time, amber warning lights on the bridge begin to flash and a horn sounds a 15 second blast every minute. At the end of the ten minute warning period, if the microwave boat detectors do not detect an obstruction, the center of channel navigation light changes from green to red, and the bridge begins lowering.

If an obstruction is detected, the bridge remains fully raised until the boat passes. If the bridge is lowering and a boat passes through the detectors, the bridge reverses direction and returns to the fully raised position until the boat passes. The bridge remains there for several more minutes before lowering again.

While the bridge is lowered and locked into place, the amber lights remain flashing. After the train clears the bridge, the bridge raises to its full height, the amber lights cease flashing, and the navigation lights change from red to green.

One problem apparently experienced on a recurrent basis at this bridge is that of marine traffic trying to beat the bridge after hearing the warnings. They know they can delay or reverse the bridge by interrupting the boat detectors, and thereby they frequently cause train delays.

Geographical Distribution of the Bridges:

There are approximately 15 remote controlled or automatic bridges in the United States, based on our informal survey of the Code of Federal Regulations. I want to emphasize that this is only an approximation. Some bridges that were listed as remote or automatic were discovered to be manned and conventionally operated, while others, we suspect, may be operated as "Automatic, Crew Operated" and are not listed as such. (The latter was the case for the Union Pacific's bridge over Cedar Bayou at Baytown, Texas.)

Distribution by Bridge Type:

These 15 remote/automatic bridges are distributed among the three basic movable bridge types as follows:

10 vertical lift bridges
5 Bascule bridges
0 swing bridges

Now just a couple bits of trivia: to the best of our knowledge, all five of the bascule bridges are in Florida and all of the bridges with the guards are in Florida.

Proposed Remote Control Bridges

We also have information on at least four more remote control bridges presently in the planning stages. Three are actually existing structures being converted to remote control, while one is a new replacement bridge at an existing crossing. Of further interest is the fact that two of these conversions are swing bridges. The remaining conversion and the new bridge are both vertical lifts. These are:

*Amtrak's west side connection over the Harlem River, existing swing bridge, controlled from Penn Station.
*Amtrak's Atlantic City bridge over Beach Thorofare, existing swing span, controlled from Philadelphia.
*Burlington Northern's A-S-B Bridge over the Missouri River at Kansas City, existing vertical lift.
*Union Pacific's bridge over the Red River at Alexandria, Louisiana, new vertical lift, controlled from yard five miles away.

II. Bridge Control Systems

At this point we will turn our attention to some of the technical aspects of controlling these bridges. The control systems can be grouped into two general categories, according to the means by which the sequencing of the control logic is achieved: relays, and programmable logic controllers (PLCs).

Relay Logic makes use of discrete relays to perform all or part of the control sequence. Even on the bridges where the sequencing is performed manually by the operator, there are usually at least a few relays acting as repeaters for the interlocking and limit switches. Therefore, we will lump them all together as relay logic.

Programmable Logic Controllers are dedicated industrial computers applied strictly to process control, or in the case of bridges, the sequence control. The control circuit itself is nothing more than an executable program entered into the PLC's memory. Since the operation of the control sequence takes place in a digital format, it is essentially ready to be interfaced with a modem for microwave, fiber optics, or radio type control links.

Nearly all of the existing bridges are relay logic. However, two of the four new or converted remote control bridges are anticipated to be PLCs. The other two of them will probably be relay logic. Even these will utilize digital multiplexed or PLC type interfaces to the control links.

The most important point to realize here is that remote control or automatic operation can be readily done with either relay logic or PLCs. The determination of which method to use should be based on capabilities of your electrical personnel who are going to maintain it.

III. Control Links

Intimately related to the bridge control system is the Control Link. The Control Link is the interconnection between the bridge control system and the remote operator station. It is the means across which the data is exchanged. There are several types of control links presently suitable for use.

Hardwired is when a control cable is physically run between the bridge and the remote operator station. The control cable may be composed of numerous discrete conductors, or it may be multiplexed, i.e., it may be numerous digital signals transmitted over a single transmission line such as shielded coax or a shielded twisted pair.

The discrete conductor type is the least sophisticated from a technological standpoint, but is limited in distance from a cost, as well as a practical, standpoint. The multiplexed method involves more sophisticated equipment, but extends the practical distance into the thousands of feet.

Leased Telephone Line is similar to multiplexed hardwired system in that the bridge control system and the remote operator station are electrically connected through the telephone company's cables. This method has the advantage over the other hardwired methods of far greater distances, such as hundreds of miles.

The leased telephone line is often a lower initial cost than the other long distance method, the microwave link. However, over a considerable time span, such as several years, the continual monthly cost of the leased line may actually accumulate to be more expensive, and may be somewhat more restrictive in terms of data transmission.

Microwave Link is one of the most sophisticated methods. In general, the control signals are usually introduced in digital format, then fed to the microwave radio transmitted through a modem. At the other end of the link, the reverse of this process must be performed. Furthermore, with full duplex (both receiving and transmitting occurring simultaneously at both ends), which is often the case with a microwave link, the system gets even more sophisticated. Thus, the cost effectiveness and, in fact the feasibility, are usually dependent on the proximity of the bridge and the intended remote site to existing microwave facilities.

There are significant advantages to the microwave link. The data transfer rate can be extremely high, higher than is often possible over leased telephone lines, resulting in faster control system response. Multiple channels can often be utilized to carry the closed circuit TV, two-way audio for external talk-back public address and marine radio, and railroad signals and communications.

Relatively short microwave links, up to several miles, may be cost effective as separate, dedicated, low power microwave systems. These systems are especially practical if a tower already exists at the remote operator station or the bridge on which the microwave antennas can be installed.

Fiber Optics is similar in many aspects to a multiplexed hardwired link. The practical range is easily several miles, but it will need amplifiers at regular intervals of no more than several thousand feet. These amplifiers boost the optical signal to make up for the attenuation through the optical fibers. The amplifiers need to be electrically powered, which means electrical power must be available at each such location. The optical cables must be run on a pole line or in buried conduit, implying the need for right-of-way or easement. The cost effectiveness and feasibility are thus highly dependent on both the distance and routing available.

One notable advantage of fiber optics is the electrical isolation. The optical fibers will not conduct electricity, making it an effective way to link the bridge or remote operator station to a tall antenna tower with maximum isolation against lightning damage. For this reason, fiber optics is being increasingly used in industry as an intermediate link where isolation from electromagnetically induced surges is needed.

Radio Link is somewhat similar to a microwave link, but is at a much lower frequency, usually in the 70-151 megahertz region. Because of the lower frequency, the data transfer rate is significantly slower than with microwave, resulting in slower control system response, in the order two seconds. Nor are the antennas usually as sharply directional. This limits the useful range to very short distances, such as hundreds of feet.

In spite of these limitations, the radio link is a good alternative for certain applications because it is so inexpensive. It is presently being used on a number of bascule highway bridges in New Jersey in lieu of submarine cables across the channel. More significant than the cost savings of the cable installation is the avoidance of the environmental impact studies and permits. While this is not remote control of the bridge itself, it is remote control of a subsystem of the bridge, and therefore bears mentioning.

IV. Peripheral Devices

A number of peripheral devices are necessary for safe operation on remote controlled and automatically operated bridges, such as: closed circuit TV, boat detectors, radar, etc. The combination of these peripheral devices utilized varies considerably from bridge to bridge.

CCTV is common on the remote controlled bridges. It is used for checking the waterway (though its usefulness at night is questionable), for monitoring the structure for unauthorized personnel, and for visually confirming the passage of rail traffic. The TV signal can be sent over one of the microwave channels.

Microwave Boat Detection utilizes microwave beam intrusion detectors of the type used for high security perimeter protection. The beam widths are usually adjustable. This is an important feature for minimizing false tripping from water surface wave action. To satisfy the Coast Guard, the transmitter and its respective receiver usually must be provided with automated elevation adjustment that monitors the water elevation and keeps the equipment at a specified height above the water surface at all times. Useful ranges up to 600 feet are claimed by some manufacturers.

Photoelectric Boat Detection utilizing infrared photoelectric detection equipment is in service on at least one remote controlled bridge, with very satisfactory operation reported. The infrared beam is active continuously day and night. The beam width is in the order of three degrees. Effective ranges up to 900 feet are claimed by the manufacturer. The photoelectric boat detection equipment is generally subject to the same automatic elevation requirements as the microwave detection system, but is immune to false trips due to water surface disturbances.

Radar is only used on a couple of bridges. Current state-of-the art radar units can be programmed to suppress the display of ground clutter close to the antenna. The color displays make them easier to interpret. Two aspects of radar application that take serious consideration are: (1) transmitting the display to the remote location, and (2), do the personnel operating the remote control station need special training for the radar? Also, it should be investigated how this may impact the employees' classifications as far as the labor unions are concerned.

Talk-back Audio Systems are public address systems with effective speaker-microphones that act as powerful outdoor intercoms. At some locations they are used to allow the water traffic (such as pleasure craft without radios) to request an opening. They are also useful for security surveillance and safety. Unauthorized persons on the bridge or piers who may be endangered by a bridge movement could possibly be detected audibly and warned.

Marine Radio is commonly used on the manned bridges. I mention it here because it can also be operated over the data link, provided the link supports two-way audio communications. This is almost always a requirement by the Coast Guard. Even on some automated bridges where no operator will ever be involved, a marine radio transmitter broadcasts a warning to mariners every minute.

V. Risk Considerations

Anytime a machine is operated automatically or from a remote location, the opportunity for personal injury or accident increases. Even though we may take extensive precautions to ensure the safety of marine traffic, unauthorized personnel, and even maintenance personnel, our potential liability has increased. Therefore, we should give thought to the various types of risks we are taking.

Personal injury to unauthorized persons, and perhaps to a lesser degree to maintenance personnel, is a serious consideration. The severity of this consideration depends largely on the particular location. We should assume that in a civil suit, we would be deemed responsible for the protection of the trespassers.

Marine traffic accidents are potentially the most serious. The possibility of loss of life, loss of the bridge, and pollution of the water could result in extreme financial burden to the bridge owner.

Delays to rail traffic are probably more difficult to assess quantitatively, and probably less severe in consequence compared to some of the others, but still must be considered since their probability of occurrence is greater. The White River Bridge discussed earlier, where marine traffic can delay or reverse the bridge, is a case in point.

Vandalism is a problem that has the potential to be troublesome on a recurrent basis. Again, this is one that will vary considerably from location to location.

Reduced maintenance may seem out of place listed as a risk, but in fact is something that must be thought out. It will be somewhat dependent on the maintenance tasks your particular bridge operators normally perform, and therefore would have to be absorbed by others. This seems to vary widely from railroad to railroad. On some roads the union contracts or company policies dictate that all maintenance is done by designated maintenance personnel. The other extreme we have encountered is a situation where all the bridge operators are licensed electricians, responsible for routine minor repairs as well as the required periodic lubrication of the machinery.

How this unmanning of the bridge affects the maintenance and therefore the reliability of the bridge will be determined by your present policies, and how you adapt or modify them for an unmanned bridge. Unlike the previous risks considered, the maintenance is under your direct control.

VI. Why Remote Control or Automatic Operation?

Through the preceding discussion, we have considered a lot of things, but we have not yet considered why we would want to unman a movable bridge. There is probably only one very good reason. It is a persistent reason: cost. Unmanning a bridge may mean reducing our labor force by four people. Considering the total annual cost to employ those four people, the savings is frequently worth careful consideration.

VII. Summary

I hope this brief overview of remote controlled and automatic bridges and some of the current technology being used will prove helpful in the consideration of these bridges on your respective roads. Thank you. (Applause)

Mr. Poulsen: Thank you very much, Mr. Bordon. That was an enlightening presentation. I used to get up at two o'clock in the morning to call the guy to turn the bridge so I would have liked something remote at that time.

Our final feature during this morning's joint session will be presented by Paul Resnik of Shearson Lehman Brothers on economics of the nineties. Paul Resnik is first vice president in the Shearson Lehman Brothers equity research department and has 21 years experience as a securities analyst and investment strategist. Mr. Resnik holds a bachelor's degree in economics from Hobart College and is a chartered financial analyst. He is a long time member of the New York Society of Security Analysts and a registered supervisory analyst. Mr. Resnik is well known at Shearson Lehman for his comprehensive view of the equity markets.

ECONOMICS IN THE NINETIES

Paul J. Resnik

Shearson Lehman Brothers

Thank you, Ron. On the plane from Minneapolis last night I was looking at the business section of USA Today and it said that oil prices soared high and recession evidence mounts. Too often when we are looking at the economic outlook we look specifically at how things are right now. It's sort of taking a snapshot when we really should be taking a movie. It's sort of as if someone took a picture of me running and caught me with my two legs up in the air and then the next day put that in the newspaper and say, "Resnik flies". It just doesn't give you the right view of what's going on. So when I do talk about the economic situation I do like to talk more about where we've been, where we are going, and only then discuss where we are within that context. Other than that you get the feeling that things are rather different than they really are because you're only taking a little snapshot of the current events.

When I look back at the 1980s I look back at a pretty good decade. A lot of people didn't seem to like the 1980s and I find that hard to understand. When we look at the various economic indicators, and they read pretty well, we sometimes do have a little trouble discerning reality. I know when the market was crashing on August 23 I was in Disney World with my two young boys. It's fun going on the rides with an eight year old and a five year old, because sometimes they have trouble discerning the difference between reality and fantasy. Then I come back to work on Monday and discovered that most investors have that same problem and then it's not too funny.

Let's talk about the reality of the 1980s. First of all the trade deficit: always expanding. Well, it wasn't always expanding. Actually it peaked in 1987 and the trade deficit last year was down something on the order of 25 percent or more from that 1987 peak and the trade deficit will be lower this year.

Let's take a look at the dollar. When I think about the dollar, there is a word that always comes to my mind that reminds me of the quarterback from Pittsburgh, not too many years ago, Mark Malone. Whenever I heard his name the announcer would say, "The much maligned Mark Malone". After awhile I never heard his name without the guy saying "the much maligned Mark Malone" and I thought Mark was his middle name and maligned must be his first. Well, when you hear about the dollar you hear about the collapsing dollar. It seems to go together, it's always the collapsing dollar. Well, the dollar has collapsed versus the yen to a 137 yen to the dollar which is about where it was in 1987 and actually higher than what it was in 1988. So the dollar has collapsed in the past three years all the way to where it was when it got started versus yen. That seems to be kind of a bizarre notion of something falling to the same place. You never hear about the rising dollar, all you ever hear about is the collapsing dollar and you have the sense that you're lower but you're not. We are lower than against the deutsche mark. We are almost ten percent lower than we were in 1987 and that's hardly collapsing.

Let's talk a little bit about inflation. Inflation is always re-igniting. It's like those trick birthday candles. But let's take a real look at the 1980s understanding that inflation is not the level of prices but the pace of increase in prices.

Yes, we had double digit inflation when we started the decade, 10.3 percent and 6.2 percent in 1982. In 1983 and thereafter, the numbers read like this for the consumer price index: 3.2, 3.4, 3.5, 1.5, 3.6, 4.1 and then in the drought-affected year 4.8 percent. So basically, with the exception of the one year when oil prices really tanked up and we had one and a half percent increase, it's kind of a non-story. One of the great non-stories of the 1980s for all the newspaper print that it used up. It makes you feel that maybe you should start a daily newspaper discussing the pace of grass growth. Little faster today, little slower tomorrow. It was kind of between three and five percent. Boy, to have written a big discussion of inflation during the 1980s it would have taken a paragraph, instead it took books and books and it was always re-ignited.

The Federal deficit, always hemorrhaging. These words just go together, collapsing dollar, re-igniting inflation, hemorrhaging Federal deficit. Well, the Federal deficit did get up to $21 billion in 1986 which was 5.2 percent of our real gross national product.

This year, with $10 billion dollars added, actually the year just ended, the fiscal 1989 year with $10 billion added from the S&L crises, we had a $159 billion deficit, which was 2.9 percent of our gross national product. So we went from 5.2 percent to 2.9 percent as a percent of gross national product of the deficit, so we were making some improvement. Admittedly, I have to agree, if you really want to get upset you just watch what goes on in Washington. If you really want to find something to ruin your day, I think there should be an investigation into the water supply from the Potomac. (Laughter) We elect over 500 people and send them to Washington. These are some of our best and brightest and personable, intelligent, driven individuals. They get to Washington and they turn stupid. (Laughter) I think it merits some investigation. In any event every year we get what one would rightly call inadequate deficit reduction measure.

So I think that if you had an inadequate deficit reduction measure every year during the eighties, a funny thing happened. You make some progress against the deficit, as inadequate and as with all the mirrors they use, it does add up. So like the late Everett Dirksen, senator from Illinois, once said, ''A billion dollars here, a billion dollars there and, after a while, you're talking about real money.'' (Laughter)

Interest rates always seem to be rising. There's two more words: interest and rising. Well, lately, they have really been rising. They shot right up. We have those 30 year long term Treasury bonds that closed at 9.06 percent yesterday. At the end of 1988, over a year and a half ago, that bond was trading at 9 percent. Three month Treasury bills back at the end of 1988 were 8.1 percent, today they are about 7.4 percent. Short rates have come down and the prime rate is staying at 10 percent as the banks collect a bigger spread to try to make up for their horrendous loans. So if you haven't noticed, your borrowing costs come down as fast as short term rates. That's not a mistake, the banks know what they're doing. They are collecting a little bit more on the net interest to help cushion all those incredibly dumb loans.

Corporate profits. You're getting a litany of declining corporate profits this year. Well, the fact is only some companies are economically sensitive. Many companies are growth oriented; many companies are defensive in nature. In reality, corporate profits this year are up a little bit if you measure it by the Standard and Poor index of 500 stocks. Indeed, in 1988 corporate profits on that index were up 36 percent. Last year with all the bank writeoffs we were down to about 3 or 4 percent and this year we are looking at about 6 or 8 percent.

I'm not going to discuss the stock market in any detail but let me just cut you in on the chase. I was on an ''Alive at Five'' broadcast from Beaumont, Texas, not long ago and the newscaster asked me whether this individual investor would return to the stock market after the trauma of the 1980s. That's a tough question to answer because they weren't very traumatic. The market provided a very positive return in nine out of ten years. The only down year was 1981 where we had our most severe recession since the great depression and one dollar invested in the SP 500 in the beginning of the decade with dividends reinvested by the end of the decade equaled five dollars. If that's trauma, give me trauma.

Let's look forward a little bit. I'll get to the present; I'm saving the bad part for last. Now when we look forward, let me make a confession, I tend to be optimistic. As Ron pointed out I have been in the investment business for 21 years and optimism has done real well for me. Real well. But I understand that's a personal thing. A lot of people aren't optimistic in their nature. It just isn't there. But I do ask you not to have that sense of negativism, although I do understand. See, I lose a lot of credibility by being optimistic. If I came before you and told you the world was coming to an end I would have a lot more credibility, because that always seems to be safe. Do you ever figure out, you know, who sells the books? There were books written in the early 1980s about the coming bull market but you can't remember those. You can remember the crash of 1989; rough times; all this stuff. This you can remember because they sold hundreds and hundreds of books because people love to read about disaster. We call these people the doomie gloomers, we call them Cassandras. Cassandra, however, was a character in Greek mythology who was blessed by Apollo, always to be able to predict the future correctly but cursed by Apollo, never to be believed. She predicted the fall of Troy; nobody believed her. That was ridiculous. Troy will stand forever. So today if somebody predicts doom and gloom, they are called a Cassandra. But that's a perversion of the name. Those predictions, those doom and gloom predictions that we had the three hundred billion dollar deficit, double digit inflation, the collapse of the banking system and one of my favorites, irreversible communism. (Laughter) Right? All there, all predicted, indeed it strikes me that today's Cassandras, unlike the one in Greek mythology who was always right and never believed, today's Cassandras are always wrong. But incredibly, always believed! So you have the whole thing backwards.

What I suggest is not that you share my optimism for the 1990s which as I have said is a personal thing, but to understand that negativism and realism are not necessarily the same thing. Cynicism is healthy but negativism very often sends you off in the wrong direction and leads to missed opportunity. So, let's try to be realistic. There are certain trends that will not be denied in the 1990s. First of all, I have to say that I've been in the investment business 21 years and during that time period I have been privy to inside information. The inside information comes from the fact that I was born shortly after World War II. I'm a boomer. It was no mystery to me why we had a housing boom in the 1980s. I bought my house. It's no mystery to me why things have slackened in the 1990s in the real estate market. I own my house and if I look to the 1990s I see another trend forming up. More every day. Unfortunately, I hate to admit it, the baby boomers are growing old. We hate to admit it. Did you ever notice that Mick Jagger at 45 years old jumps around the stage without a shirt on. (Laughter) We do hate to admit it but we are growing old. And the population is indeed aging and we will, as a country, be spending more on health care as a percentage of gross national product and that is a trend that will not be denied.

There is a positive aspect to this because while this is all happening we are in the midst of an explosion of new and exciting drugs brought to us from the field of biotechnology which was, indeed, a glimmer in people's eye ten years ago but is no longer just a glimmer in people's eyes. You will see drugs coming to the market that will save hundreds of thousands of lives and not in the distant future but in coming years. Drugs to reduce the need for blood transfusions, drugs to combat septic shock which is the seventh largest killer in the country. You don't hear much about it because they usually call it something else. They usually call it complications. New diagnostic tests, particularly in hepatitis; new vaccines. So health care has a lot of opportunity but as I pointed out with the explosion in the cost, just because of the demographics you're also going to see a growing uproar to keep costs under control. And see, that's another advantage of my age group. We are a big voting block and as we grow older our concerns become the focal point. Child care, for instance. You see where all the yelling is, for instance. There has always been a need for more child care, day care facilities. Where was all the yelling and screaming before? Now, it's there because you have this post-war baby boom block coming through. So one of the big things you are going to see is the demand for controls on cost because health care is going to be a rising percentage of that economy in any event and if we don't control the costs there we have some major problems.

Other areas are infrastructure and the environment. When I say infrastructure, I mean our highway system which was mostly built in the 1950s. It is old, the bridges need repair and you just cannot push that off indefinitely. We have some overdue things to address.

With regard to the environment, I don't care if you are a Republican or a Democrat, the environment also has reached the point where it needs to be addressed. I know that I spend a lot of my career flying between New York and Los Angeles. I get into Los Angeles and the air is an abomination. It is an absolute abomination down there. When a New Yorker complains about the air they have a problem. So we're going to have to do something about the environment in the 1990s, but if we have to do something about our infrastructure and our environment, let's look across the ocean. You talk about the economic unification of Europe, well that's fine. But how is that going to be accomplished? How do you communicate? How do you ship? Where are the roads? Where are the rails? It's great to talk about it but if you're suddenly going to say more trade, more flow of people, how do you accomplish that? There has to be massive investment in the infrastructure in Europe and when it comes to the environment, while we may feel that we have some shortcomings, they certainly have them in western Europe; and eastern Europe is an abomination. Communism has sinned against the environment as we would not have dreamed to do. So the 1990s sees opportunity in those challenges to repair, to mend, and to clean up.

Communications. I watched the previous presentation regarding remote control. Well, communications is still an exploding area for our economy and while some of it is high tech and esoteric, we know a lot about it because we all own telephones. We are all part of the communications revolution. And as fiber optics upgrade phone lines around the country you will find telephones being used for all sorts of things like networking, not party lines, networking. You will see telephones used for an ailing population, for medical alert, and monitoring programs at home. You will see telephones used for entertainment. There is a test going on that just started this year in California called Dial-A-Video. You want to watch a movie? Call it up. You want to go to the refrigerator for a snack? Put it on pause—all over your telephone. You really like this movie and you think your brother would like it, send it over to his house. I can't even begin to figure out what they are going to do with that telephone. But may I assure you that communications will be another great growth area. Indeed, it was the explosion of communication channels that created a lot of the takeovers in the entertainment industry—Columbia pictures by Sony, Warner Communications by Time—as suddenly people discovered we had more lines of communication than we had things to say. So suddenly everyone wanted some product.

The fourth area was an area of opportunity before the current crisis in the Persian Gulf, and that is energy. In the 1980s we saw energy prices coming down after that hike up in the 1970s but in the 1990s we anticipate rising energy prices. We have no more North Seas, we have no more North Slopes and we started the decade importing as much or more oil than we did in the worst moments of the 1970s. So energy independence is a mirage. We started off on that road over ten years ago and then discovered that the price of oil went down so maybe we didn't have to do it. Right? So now we're back to square one. We will have to meet rising demands for energy. In some cases, it's rather specific. I think the auto travel has a problem here. As a nation we want low vapor, high octane unleaded gasoline. That's great. Now let's build an oil refinery next to your house and we'll have some.

In California with all those cars running around they have to have cleaner burning fuels. That's wonderful but no more refineries. So we're going to have some areas of shortage in refined products. I think there are some areas of opportunity here in natural gas which is plentiful, it is clean, it is cheap, it is domestically sourced and the pipelines are being built and the fields are being drilled. I think the immediate movement by utilities to get additional capacity will be a natural gas turbine. However, as we get toward the mid-1990s and to the late 1990s I think you are going to see the completion of a lot of new coal-fired plants with the wet scrubbers and the low sulfur coal from the west as the answer. Let me put it this way, if we were to suddenly overcome ten years of paranoia and rediscover nuclear energy it still won't help the 1990s. You couldn't possibly have production on line in that time so that is a non-starter. Oil is a problem so that leaves us with natural gas and coal, and one would expect that coal is the fuel of supply in this country; we just have to use it a little more smartly.

So there we are. Health care for an aging population. We need to clean up and fix up the country, infrastructure and environment. Communications. Energy. Great growth areas in 1990. We foresee a global market with the dollar where it is where we can, indeed, compete overseas and certainly within the next few years perhaps to see that trade deficit turn around into a trade surplus in these international markets. We think we have a lot of things we can sell to Europe and to the Pacific rim and we think those economies will move into a consumption mode in the mid-1990s.

So everything is wonderful. No, everything isn't wonderful. Let's take a look at where we are. The trade deficit which has been improving and, indeed, looks pretty good through the first half of this year, will come to a grinding halt in the second half of the year because of rising oil prices. Sluggish economies overseas will tone down the pace of export growth. Combine that with high oil prices and you will discover that our trade deficit improvement, at least temporarily, will come to a halt.

Given the current higher foreign interest rates, prospects for a weak United States economy and the rising federal deficit, the dollar should continue to be on the defensive. Be on the weak side, not collapsed, but it will be more prone to go down than up.

With regard to inflation, we will see a spike up in inflation. We'll see rates of inflation that we haven't seen in a long time in the third and fourth quarter of this year. We're looking for about a six and one-half percent of increase for the consumer price index in the third quarter and about six percent in the fourth quarter because of the impact of energy prices. Let me point out in this respect that the good news on inflation and energy is that this is not 1973 and 1974. This is not 1979 and 1980. In 1973 and 1974 and 1979 and 1980 the economy was chugging ahead at a real GNP rate of gain of over five percent in both cases. You already had a very strong economy that this inflationary push was introduced to. We have a weak economy. It was moving along at between one and two percent.

Oil consumption as a percent of personal consumption expenditures were 4.1 percent in 1973-1974; 4.5 percent in 1979-1980; 2.9 percent most recently. Even if you don't feel it, the car you are driving is more fuel efficient, the homes you live in are better insulated, energy has been reduced as a percentage of our economy. So you have this combination of energy being a smaller part of the economy as a cost of doing things, combined with the fact that we don't have an inflationary bias to the economy to begin with. It's not so strong; we don't expect that this spike in oil prices will result in a permanent lifting up of the inflation rate. We're talking about a couple of bad quarters.

Let's get to the federal deficit. Well, so much for improving federal deficit. What we have here is a recession and we do have a recession. We have the S&L problems and they are monstrous and an undefined military cost of what's going on in the Persian Gulf. It's undefined because we don't know to what extent. We have a lot of pledges; we'll see how the cards come in as to what all this costs us. With regard to the federal deficit for fiscal 1990, we're looking for a record federal deficit of $226 billion, which beats fiscal 1986 of $221 billion. Of course, in there is roughly $50 billion from the S&L mess. That's still, of course, only 4.1 percent of the gross national product so on that adjusted basis it isn't quite as bad, but we've given up a lot of the progress and we're still looking for a federal deficit of $223 billion next year, even after they make a big show of how they are cutting the deficit, which will bring you to 3.9 percent of the gross national product. So basically, the improvement in federal deficit has stalled for now, thanks to the S&L mess and the sluggish economy. Quite frankly, this isn't the best time to be cutting the federal deficit into a recession and I think that's going to kind of stay the hand of an already ambivalent deficit cutter.

With regard to the interest rates, we think long term corporate bond rates are stuck around the nine percent level for the foreseeable future, given the level of inflation and the stalling of the trade deficit improvement and the height of the federal deficit. So we're stuck around nine percent. Short term rates may continue to come down but only grudgingly. In other words, Chairman Greenspan is likely to respond to signs of a recession with lower short term interest rates. He is not likely to anticipate a recession and try to prevent it. He is likely to try to mitigate a recession after it is already clearly begun. We are in an environment with the level of inflation and the federal deficit what it is that if the federal reserve was seen trying to anticipate a recession, their role as the world's last fighter of inflation would be cast into doubt and most likely you would have an absolutely perverse effect on the long end of the interest rate market. The long bonds, the people who are affected by inflation, would most likely demand higher and higher rates. So the federal reserve is in a bind and likely to only lower interest rates as the news becomes so bad it cannot be ignored.

Corporate profits. We're looking for flat profits in the second half of this year, actually most likely down profits in the first half of next year and in the second half of 1991 a resumption of rising corporate profits.

With regard to the stock market, I'll just mention all of this terrible recession, the good news is it's most likely already in the stock market. It's not news to the capital markets that we're having a recession. The market has already declined by a greater amount than earnings estimates are likely to have to come down, but what the stock market cannot predict, of course, is what's going to happen in the Persian Gulf. And that kind of brings me to what is going to happen there and how does that affect the economy and how do we respond to events of this nature. There are trends which cannot be denied and then there are events. Let's talk about some events that we may remember. In 1961 President Kennedy gave a verbal thrashing, he called it jawboning at the time, to the steel industry: Keep prices under control and there was a sense of President Kennedy saying some pretty derogatory remarks about businessmen. There was a sense that we had an anti-business government and the stock market really came tumbling down. But business did very well in the 1960s. They grew, they made profits, they did extremely well and yet you had this event. In the 1970s President Nixon put an end to inflation by putting on a price freeze. Well, that was pretty exciting. Of course, that was the forerunner of double digit inflation. We entered the 1980s having just witnessed the fall of the Shah of Iran and we had wide-scaled predictions of oil prices going to $40, $50, $60 a barrel. I remember sitting at presentations with the price of oil around $35 a barrel and listening to people be conservative. Let's assume the price of oil only goes up ten percent a year for the next decade. That was a conservative view. Nothing goes up like that. Nonetheless, the price of oil not only didn't go up ten percent a year, it went down in the 1980s. So here you have the jawboning against the steel industry didn't stop the growth of business. The price freeze from the President didn't stop inflation and the fall of the Shah of Iran did not stop oil prices from coming down in the 1980s.

I know early in my career when I was standing in front of a terminal hitting up some prices and I believe this was during the price freeze, I turned to a senior analyst and I said, "Boy, it's a whole new ball game," and the analyst looked at me with one of these bemused smiles and said, "It's never a new ball game." And I think that's important to keep in mind. We are so mesmerized by what's going on in the Persian Gulf that we may feel frozen or otherwise unable to take action because of this great uncertainty and if you're talking about the next couple of months I would say, that's true. We at Shearson Lehman Brothers work on one assumption. The assumption is: Iraq loses. Beyond that it's very difficult to anticipate the cost or the timing of this event. And the cost may be considerable and it will certainly blot out all other considerations while it is happening. But if we look longer term, let's get sensible. Because Iraq invaded Kuwait we will not stop growing older. Nobody will create a magic elixir to keep us all young. Health care will still demand a greater percentage of the gross national product in the 1990s than it did in the 1980s, no matter where these Iraqi troops are located. Because Iraq invaded Kuwait, our bridges and roads will not repair themselves, our air will not become clean as a result of this invasion. It just won't happen. Because Iraq invaded Kuwait we will not cease using telephones and communications, microwave satellite communications. Certainly a decade from now you'll have the railroads being run by satellite, I guess. It won't be stopped. It will go on and because Iraq invaded Kuwait our energy problems in this country and our need to develop new domestic sources will not be alleviated. That's pretty obvious.

So I think the key focus here as we look at the near term difficulty and understand that gross national product will be lower in the fourth quarter of this year and the first quarter of next, we are going to have a recession, inflation will have a couple of quarters where it will be higher than we have seen it for quite some time and unemployment will spike up to seven percent next year as a residual up from the mid-five percent range where it's been for quite some time. Recognizing all of this, the fact remains, trends remain trends and will not be stopped because of an event. So that is our outlook. It is rather cautionary near term. We believe the consumer is ready to fall off a cliff. Things are going to slow down, but as we look further out we feel that the United States economy is well primed to participate increasingly as an exporter in the growth of a newly unified Europe and a continuing rapidly expanding Pacific rim. So that's our economic outlook for the 1990s. (Applause)

President Pottorff: Thank you, Mr. Resnik. That's very enlightening. This ends our joint session for today. Following a short recess Roadmasters will reconvene in this room at 10:45 and B&B will meet in the State Ballroom at 10:45.

Recess

TUESDAY MORNING SESSION

September 18, 1990 — 10:45 a.m.

President Burns: The second session of our 95th Conference is now in session. At this time I will turn the program over to Don Sorgenfrei, sponsor of this morning's special subject presentation. Don.

Mr. Sorgenfrei: Thank you, President Burns. It is my pleasure this morning to present our next speaker, Mr. Don McCammon, who will present Special Subject No. 3 — Computerized Structures Management Systems. Don is manager of bridges and buildings on Burlington Northern's Denver Division. Prior to his railroad career he spent six and a half years on road and bridge construction for the Montana Department of Highways. He started with Burlington Northern in 1982 and has held positions of management trainee, assistant roadmaster, assistant B&B supervisor, assistant structures engineer and assistant manger information systems. As BN's systems engineering manager of information systems he started the development of the railroad information system, RIS, BN's facility data base which assisted greatly in this subject to be presented this morning on computerized structures management systems. Don is a graduate of Montana State University and a registered professional engineer in four states. He is also a member of AREA Committee 7 and the American Society of Civil Engineers.

SPECIAL SUBJECT NO. 3

Computerized Structure Management Systems

Chairman: D. L. McCammon, Mgr. Br. & Bldgs., BN, Englewood CO

Committee: M. L. Johnson, BN, Overland Park KS
A. S. Uppal, Mgr. Br.& Strs., CN, Edmonton ALB
R. B. Kelly, Mgr.Strs., C&NW, Boone IA
B. R. Anderson, Engr.of B&B, Conrail, Harrisburg PA
R. W. Kaye, Sr.Proj.Engr.-Strs., EJ&E, Joliet IL
E. W. Koch, Long Island RR, Jamaica NY
B. E. Peterson, Engr., Modjeski & Masters, New Orleans LA
H. B. Matthews, Port Authority of Allegheny County Transit, Pittsburgh PA
W. S. Riehl, Seminole Gulf, Fort Myers, FL
J. Eldridge, Mgr.Br.Mtce., UP, Omaha, NE
J. A. Lileikis, Mgr.Strs., UP, Omaha NE
R. Sheets, Sheets Masonary, Elkview WV
D. E. Bartholomew, Sverdrup Corp., Bellevue WA

Introduction

Structure Management is the systematic organizing and performing of activities in planning, designing, constructing, maintaining, repairing or rehabilitating and replacing of bridges, buildings, culverts and other non-track items vital to the hauling of freight and passengers on our railroads. Without the structures we care for, 200 ton locomotives would have to sprout wings every time they came to a stream, train crews would have no place to store their grip, not to mention how the locomotives get fuel and how shops are kept warm and dry. In recent years, a new tool has replaced an army of clerks, drawers and drawers of paper files and, in some cases, the very plans we use. This tool, called the computer, is being used to change the way we perform structure management.

As structure managers, we need to find effective ways to perform our functions of maintaining an inventory of what we manage and what condition that inventory is in. We need to plan and monitor our work on these structures and, since none of us have Fort Knox in our back pocket, we have to budget for this work. This report discusses the functions of structure management, introduces some basic computer terminology, presents a systematic process to develop computerized tools and looks at the current state of structure management on a wide cross section of railroads.

Structure Management Functions

As bridge and building personnel, we all perform the basic functions of inventory, condition, planning and monitoring maintenance and replacement, and budgeting for the structures under our control. The records we keep about what the structure is composed of is similar to any other type of inventory system. We maintain various indexes to enable us to find design plans and other structure information. We record changes to the structure, audit the accuracy of the records, keep track of improvements or new structures and maintain an historical file so we know what happened in the past, i.e., what occurred during the flood of 1950 or what damage was caused during the fire of 1912. Plans are stored in original, as well as microfilmed, and some are now on computer disks. Other means of storing information about a structure are ‘‘tangwall’’, or profile sketches with various bits of information on important components of the structure. Notice on this profile the note on the scour and washout that occurred in 1966. You will also note that no record was made of the repairs made.

Inspecting, recording the inspection results, rating a structure for its capabilities to handle today’s traffic, recommending repairs and maintaining a history of the structure condition are how we spend a major amount of time. As bridge and building professionals we are like doctors giving our patient structures a periodic health check, diagnosing ailments and dispensing remedies. We physically perform inspections of our structures noting deficient conditions, poor ties, or badly cracked concrete. We then generally assign a condition rating, for some a simple okay, to as exotic as a numeric rating code from one to ten. We then record our observations on a form, in a book or by some other means and then store the information on a shelf or in a file sending copies to whoever needs it.

Once we have obtained our list of repairs and work needed, we then plan the activity. Once work begins, we monitor the progress, keeping track of the labor, equipment and material used. We do some sort of cost analysis to determine the most effective and economic work that will optimize the utilization of manpower, equipment and material. We prioritize the work, schedule the projects, material delivery, equipment and the crews. Barring emergencies and sudden changes, the work is performed. As the work is performed, we report by payroll, labor distribution forms, equipment usage and material usage sheets what we actually did and what it took to do the work.

As we do our planning we also perform another management function, that of budgeting. In today’s world of optimizing stockholders or owners return, the demand for utmost optimization of the scarce labor, equipment and material resources is increasing. Proper budgeting for capital and maintenance dollars is critical to the proper care for our structure. We need to know what it costs to do our work and what work will be required in the future with the monetary, labor and other resources that will be justifiable to upper management in order to gain approval for those projects. We have to be able to show that our proposals are economically sensible, not just short term in effect, but also over the life cycle of the asset.

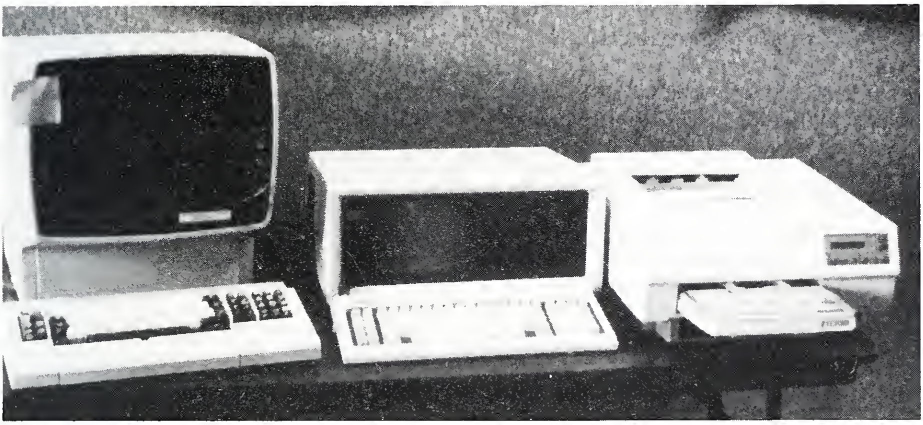
The penalty for failure to do these functions well is inadequate funding for our work, man, machines and material not being used effectively, untimely or ineffective maintenance, and bridges being replaced too soon or too late. Not performing these functions can lead to structural failure. However, due to past maintenance practices, engineering design and a lot of hard work, railroads have an excellent safety record. So far.

The Computer

Why computerize these functions? Why go to the additional expense and time of buying a black box, feeding it and hoping it regurgitates useful information? In the past, bridge management functions were performed by an army of clerks. The army no longer exists. Fewer people are around to even perform the engineering work involved. Top management has mandated they need answers to their questions. How else, on some major railroads, are you going to economically and effectively manage an asset with a replacement cost of four billion plus dollars not to mention the buildings, water systems, culverts and sewers we are responsible for? The FRA is constantly looking at developing rules concerning the inspection and safety of our structures. We need to show them that we can do it ourselves without a lot of federal red tape. No one of us can afford the time to search through thousands of files, myriads of book records and the heads of retired people to find information about our structures. For all those reasons, the use of a simple, understandable and easy to use computerized system as a tool to manage our structures is as important today as the drafting pencil and Cooper’s Load Table was 100 years ago.

But first, how do we go about developing this simple and easy to use tool? What terminology is used? What do we, as bridge and building professionals need to know about developing these systems?

Most field people and, to some extent, engineers have the perception that computers are a black box that spits out information at the touch of a finger tip. This wishful thinking has led to some major catastrophes in the past that, to this day, prevents upper management from



Mainframe terminal, PC, small printer.

approving new system development. One must understand the terminology and the technology to make effective and efficient use of a tool. However, you do not have to have a degree in computer science or know foreign languages such as COBOL, FORTRAN, C, or others. One needs to understand the "garbage in garbage out" or GIGO effect and be willing to devote some time in the beginning to become comfortable with the computer's use.

An article several years ago likened our working with the computer to guerrilla warfare. Following are some of the terms that we can use and understand to win this warfare.

The mainframe is a large, expensive and fast (given the amount of data they usually handle) collection of electronic equipment that is used for major applications. They are typically used by large railroads and not only do they perform engineering functions but also those for accounting, transportation operations and other departments. For those who have IBM equipment, you will hear the term "Big Blue". This is simply because IBM paints their computers blue. There are some software packages available for these computers but most systems involve programming, or developing a set of instructions for the computer to meet each individual application.

The opposite end of the computer scale is occupied by the PC. These range in price from $500 on up depending on how many bells and whistles you wish to buy. Normally a user will buy prepackaged software, "computer instructions", that will perform the functions needed. The mainframe and PC are called hardware or the physical parts of the computer.

Programming is the process of coding, in a language that the computer understands, a set of instructions telling the computer to do something. The brain of the computer consists of a bunch of on-off switches. The coding you place in the computer, which still has some resemblance to English, is compiled, or translated, into machine language so the computer will do what you want. The key point to remember is that computers will only do what you tell them to do. If you instruct them wrong you will get wrong results. This is GIGO.

The file of information used to sort, file, edit, delete, add to or develop results from what is called a data base. The types of data bases most commonly used are: relational and hierarchal.

A hierarchal data base was first used as it matched the accounting functions, the earliest commercial systems, perfectly. You will hear terms like parent/child, or something owns something else. An example, a bill has vendor, address, purchase made, and total cost. Purchase made has item, quantity and amount. With a hierarchal data base you can only obtain the item and quantity information by going through the bill and then purchase made data. IMS is the main hierarchial data base system.

A relational data base uses a table structure. You no longer have something owning something else or parent/child relations. Information is related because you say it is. In the above example, the information about the bill is stored in a table. If you want a report on item and quantity, you ask and you receive. You do not need to know that item and quantity are owned by anything else, just the table they reside in. DB2 is the mainframe relational system by IBM. PC based systems have DB3+ and others.

It must be pointed out that engineers think rationally. We start with a survey station, and place track, structures, etc. at that point. Track does not "own" a survey station.

Networking has evolved in today's computer environment as the recommended optimal use of computer systems. You can use the mainframe to store large amounts of data. You can use a smart terminal connected to the mainframe as well as other smart terminals to draw down sections of the data that you need to work with on your own machine. Once complete you can upload your information so others can use it. You can also communicate with your neighbor without involving the big computer. Terms like electronic mail, electronic desk tops, windows and office automation have come into being.

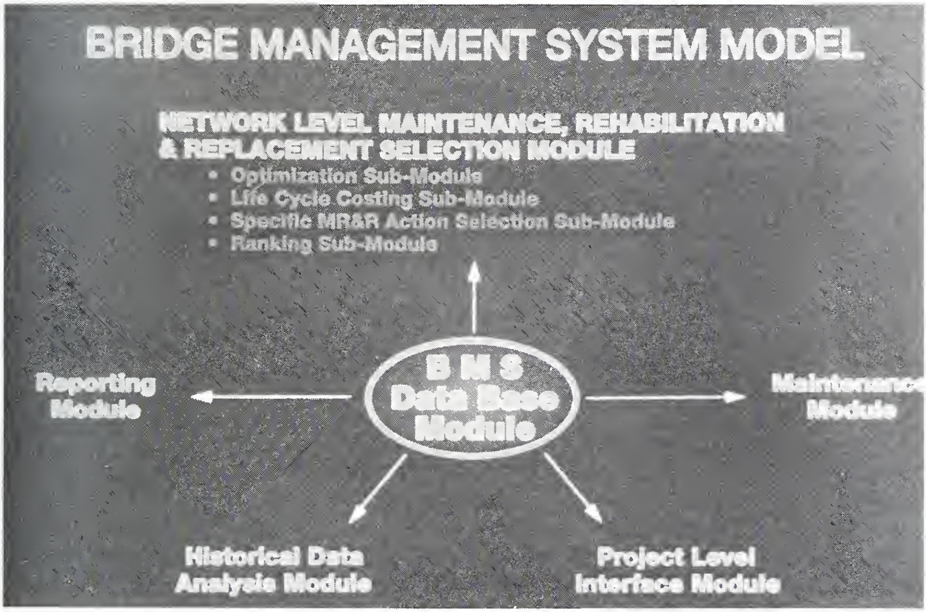
A CRT is a "dumb" terminal that connects to a remote computer. It allows input and output but you cannot draw down information to do additional calculations. A PC is just what it means, personal computer. It sits on your desk and allows you to have complete control over the computer. With networking it can also act as a CRT with the added benefit of being able to draw down to your PC the information you want to work with. Hand-helds and laptops provide a means for field people to use a computer as a tool in their jobs. With modems, telephone connections, they can tie to a central computer and share information.

Obviously, there has to be some way to navigate through all the software and hardware options in order to develop a system that will provide bridge and building professionals a computerized tool to aid us in our jobs. This development methodology has many of the same steps as designing and constructing a bridge or building. Five phases of development are generally used. If any of these phases are not fully completed the system will not meet our needs and there is a high potential for GIGO. Conceptual design, detail design, programming, information conversion, system use and revision is a frame work and methodology used to develop that easy to use, simple system.

Handheld computer.

Conceptual design develops the answers to the functionally needed and provides a framework for the system to be built on. What business purpose will be met? What data or information will be needed and where will it come from? Who and how will the information be used? What hardware and where will it be located? How much will the proposed system cost? Representatives of all departments with the potential, no matter how big, to be affected by the proposed system should be involved in this phase. This will broaden your support and ensure that the proper functions will be performed. This is critical to the longevity of your system.

Graphical presentations of how the various parts of the system fit together or are related are critical to the eventual success of the system. Shown is a model bridge management system. Central to the system is the structure data base. All other processes revolve around this core information.



BRIDGE MANAGEMENT SYSTEM MODEL

NETWORK LEVEL MAINTENANCE, REHABILITATION & REPLACEMENT SELECTION MODULE

- Optimization Sub-Module
- Life Cycle Costing Sub-Module
- Specific MR&R Action Selection Sub-Module
- Ranking Sub-Module

B M S Data Base Module

Reporting Module

Maintenanc Module

Historical Data Analysis Module

Project Level Interface Module

During conceptual design a preliminary estimate of how big a beast you are trying to create is developed in addition to a project timetable. This allows management to scale back the project or identify exactly what functions to develop immediately as opposed to developing everything at once.

Once the framework is developed, the detail design phase can begin. How can the flow of information be optimized? For example, instead of having several sources of the same data, can the system use one source with everyone having access? Picture the information flow for a project management system. The entire process is detailed from budgeting, planning, scheduling, monitoring and controlling work performed, evaluation, back to budgeting. In addition, information needed or provided by accounting, budgeting and updating the asset data base is also shown.

During the detail design phase the actual data elements are chosen. The number of characters each bit of information will be, and hence the storage space required, is actually determined. Detail flow charts are developed to show how every step of every process will be performed. Entry and query screens are developed to allow the users to comment on how they will be using the system and to ensure the system meets the required functions. Again, representatives of all people who have the potential to use the system should periodically review progress and developments to ensure that they are obtaining what is needed.

As in the conceptual design phase, another estimate is performed based on the actual design. Final approval is made and the project moves into the actual coding or programming phase. Each part of the program is tested, how the parts fit together is tested and finally the entire program is tested. Once testing is complete, any existing data can be converted to the new system. If no computerized data exists, other sources must be used. This information gathering effort should also be included in the cost estimates. The new system is now ready for use and abuse.

Do not expect a computer system to remain unchanged. Business uses vary, new ideas and concepts are introduced. Companies merge or are bought and sold. More information is required. It is commonly accepted among computer professionals that a system that has remained in place more than five years without changes is a stagnant system and needs major overhauls. A computer system will constantly be evolving, hence the emphasis on the conceptual design to ensure that the system will meet everyone's requirements, sometime.

Current Railroad Practice

Currently, all railroads are performing all the functions, inventory, condition, plan and monitor and budgeting, of structure management in some form. None of the railroads that returned a questionnaire perform all the functions using a computerized system that provides a flow of information through all the functions eliminating duplicate files and information. Practically all railroads have inventory information computerized. The majority has some sort of file or computerized fields that contain the condition information. Some railroads use the computer to plan and monitor their projects and all generally have a separate system for budgeting.

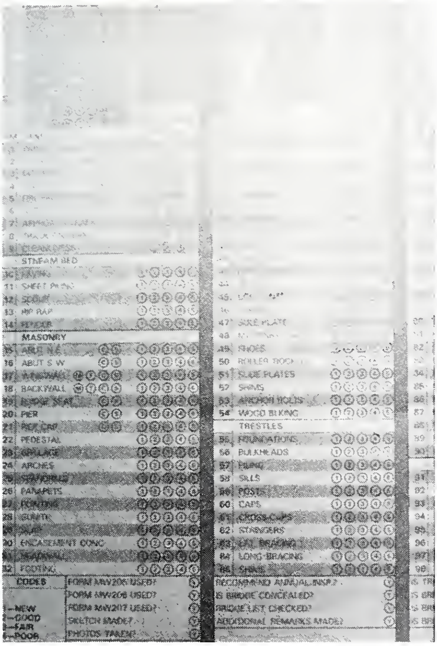
Recording information about each structure completes an inventory of these important assets. All railroads questioned have inventory information in the computer in varying degrees of completeness. Recording changes, auditing the accuracy of the information, recording new structures and maintaining a history of the structure have been relatively easy to computerize. Computerizing the actual plans has been difficult due to the complexity of taking a drawing and turning it into computer format so it will reproduce the drawing accurately. However, one railroad is exploring doing just that and completely computerizing all bridge drawings so a field person can look at the drawing on a screen at the same time someone in the office is looking at it instead of waiting for the mail to bring a copy out to the field.

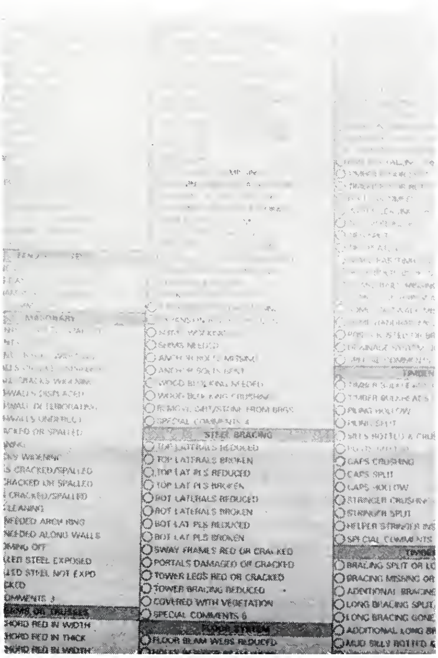
Inventory information is being used in many forms. The age and type of structure has been used to predict replacement and repair needs. Bridge ratings are used not only to determine if a structure can handle today's loadings but also to clear heavy and wide loads. These loads generally represent very profitable traffic. Age and ratings together with the type of structure can be used to better perform long range planning or through analysis determine problem structures based on design features. Wouldn't it be nice to ask a computer to give you a list of all bridges constructed in the mid 1970s with welded steel girders containing category E weld details and have this information in several seconds instead of weeks of reviewing design plans or months to perform a field audit.

It is extremely difficult to computerize the actual performance of structure inspection. Recording the inspection results, the rating, recommended repairs and developing an inspection history have been computerized by several railroads. Some railroads, as in this example, hand write the inspection information and send it in to a central office for entry into the computer. The handwritten record is kept in a paper file to store drawings and pictures. Also included in the inspection information is a condition rating. The computerized information is printed out and placed with the pictures to prepare detailed reports for some of the major structures. Not only does this railroad have a detailed list of repairs needed to a particular structure, but these repairs are now in a medium that all people involved in budgeting, maintenance planning and work scheduling can easily work with the information.

Shown here is the inspection form used by the Federal Highway Administration and several states. As you can see it is very complex, uses a lot of codes and requires a lot of information. It also requires that the form be sent to a central location for entry by another person into the computer. Contrast this to the forms used by several railroads. The forms are relatively simple and use coding that matches how a bridge person thinks. They still require the entry of the information into the computer by a third person. One railroad has developed what appears to be the ultimate system. They use a preprinted form that the inspector fills out in the field by simply filling the spaces. Not only is condition information noted but on the back are several most used comments that can also be completed. The form is sent to a central location where a clerk can run it through an inexpensive reader thereby placing the data in the computer for all to use.

One railroad has combined inspection and inventory to produce a report listing major components of the bridge and a general inspection and condition history. One of the comments made involves the necessity for common inspection across the entire railroad. The comment from the Federal Highway Administration who went through this process with all 50 states was



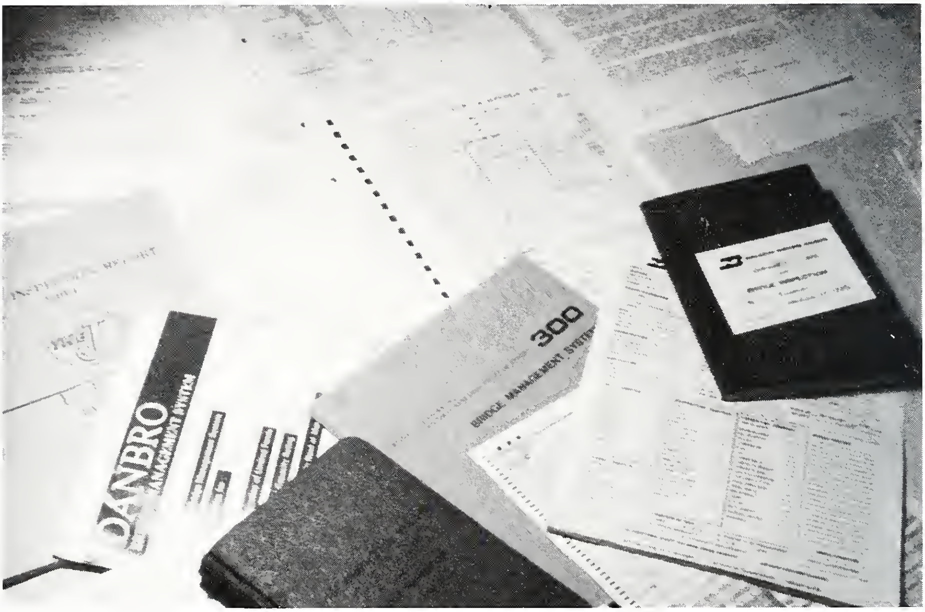


that inspection training was the key to having relatively uniform inspection results.

Most railroads are planning and monitoring their maintenance and replacement projects by hand. They do not have one system to aid the bridge and building supervisor or crew foreman in scheduling and tracking their work. All railroads have a payroll system but very few have this tied to any other system. Some railroads use PC based project management systems for major projects. Practically all maintenance activities are scheduled by hand based on a supervisor's understanding of the work to be performed and his current availability of equipment. It is a special supervisor who regularly and periodically updates his schedule and work plan while he is trying to drain a swamp knee deep in alligators while at the same time optimizing his crew, equipment and material usage and ensuring that the repairs he will perform make economic sense. Let alone have the crew foreman aware of what is happening and where he will be working the next day.

Last we looked at the budgeting function. All railroads have systems developed for their capital and operating budgets. All of these systems are owned by the accounting department and perform a financial function. Unit costs for replacement work are developed by hand from information usually gathered from after the fact reporting on an AFE (capital) monitoring system. Maintenance budgets are usually based on the previous year's budget and a feel for the work to be accomplished the coming year. Then the budget people always seem to say we are asking too much and to reduce, slash or get rid of our projects. Amazingly enough our projects do seem to get accomplished within the budget people's guidelines. But were the true costs accounted for? Was the work economically performed from a life costing standpoint?

One railroad very nicely summarized the country's status: "the bridge listings that begin each section as well as the bridge inspection report forms with comments are generated and printed directly from the computer data base. Future plans include expanding the system to work as a programming tool for scheduling bridge repair work and assisting in budgeting. Unfortunately this is still a way off".



The multitude of systems.

The Questionnaire

Information about structures management was received from seven railroads and several railroad/engineering consultants. The railroads ranged in size from one having 200 bridge structures to several that have 12,000 bridges. Bridge maintenance and replacement budgets alone ranged up to fifty million dollars annually.

The large railroads tended to use mainframe computers to develop their systems. However, one of these railroads placed their information about steel structures in a consultant-developed PC based system which provides easy access to information on their critical structures. They use the mainframe systems for their timber bridges.

For the most part, bridge and building professionals have developed their own systems. Some have used consultants, either purchasing ready made software or using computer systems professionals through every step of the development process. It appears that we have difficulty obtaining upper management's blessing and scarce inhouse information systems personnel to assist in our effort to develop structure management systems to enable us to effectively perform our jobs.

Programming and system development for mainframe systems tend to run over $100,000. Most of the large roads have bridge systems developed inhouse by bridge engineers. A few have used consulting firms. On the bright side, hardware costs are virtually nonexistent as they are part of the existing railroad's computer network. The smaller railroads all have developed PC based systems. Software costs ranged between $20,000 and $50,000, while the PC itself costs around $20,000. All of these PC systems were developed by bridge and building professionals. Every reply noted that a multitude of computer systems existed within their company that required the same information, yet no one wished to attempt to centralize the data or work towards one source of common information.

Bridge and building professionals have developed unique systems that fill the critical needs they identified to enable them to effectively and economically manage the structures they are responsible for. They have also used consultants and purchased hardware or software that suited their purposes. We are surviving the guerrilla war with the black box.

Our survival has not been without a few pitfalls. A majority of the respondents identified that upper management had a lack of commitment or even understanding of what they were trying to develop. Debugging, or correcting programming errors, and getting the system to run correctly took longer than anticipated. It was recognized that proper documentation and user manuals were necessary for successful system operations, especially in a time of constant personnel changes.

Different systems developed in the past for different purposes hindered data conversion and increased the cost of system development. Track number is a good example. We use "S" for single track; "1" for main 1, "2" for main 2, etc. This is extremely standard for our craft. However, this led to at least an hour long discussion with a systems analyst who strongly felt that the data element should not be called track number since "S" was not a number. Pride of ownership of separate systems also prevented an initial free and open sharing of ideas until all parties involved had been made aware of the benefits of working together.

The people who feed and care for the mainframe, the computer experts, were viewed as stumbling blocks due to their reluctance to utilize software that met engineering needs. Most railroads appear to feel that structures are a relatively minor cost and of lesser importance and as such will not allocate scarce funding and resources for development of structure management systems.

Benefits

Following the five phases of system development from conceptual design to system use will help prevent many of the pitfalls noted earlier. This methodology will help realize the following benefits from using a structure management system:

- Improved organized knowledge of structure conditions across a railroad.
- Comparisons of structure conditions based on various operating and environment conditions.
- Optimizing and prioritizing structure maintenance and replacement projects.
- Perform life cycle cost analysis to choose the most economical and cost effective maintenance and/or repair alternative.
- Using historical information to predict future structure maintenance needs.
- Capability of developing computerized models to predict structure performance and deterioration.
- Enables managers to quantify the effectiveness of maintenance and replacement strategies.
- Enables scheduling and tracking on not only major structure projects but also minor repairs and maintenance performed on structures.
- Allows a rational way to program limited funding and resources
- Actual costs are used to develop realistic budgets and life cycle analysis.

It is difficult to quantify these benefits, just as it is difficult to say how much will be saved by doing your job better. We may discover that maintenance costs should increase, replacement might decrease or we may find that all costs should increase to realize a maximum long term savings determined by using a completely integrated structure management system. Effective structure management, utilizing the computer as an aid, allows the bridge and building professional to make rational decisions regarding the most efficient ways to spend available funds and optimize the utilization of manpower and equipment resources.

Summary

We have looked at a recommended methodology for developing a computerized, integrated structure management system. Conceptual design allows one to look at the big picture and ensure that all people and departments necessary become involved in the development. Detailed design fleshes out the framework and provides a clear map with which the programming process can take place. Once the system is fully tested, information conversion can take place and use of the system can begin. It must be remembered that computer systems cannot remain unchanged. If a system is more than five years old it is probably not meeting your needs nor optimizing the use of the computer.

We have discussed the functions performed by a structure management system. While most of us maintain inventory and condition information, these records are not easily accessible for use in planning and monitoring repair and replacement projects nor are the costs of this work readily available for use in the budgeting process.

In looking at the current state of the art of structure management system we have discovered that a multitude of systems exist and are being used to determine the most efficient and effective way to care for our structures. Bridge and building professionals are developing their own systems due to lack of support, lack of understanding and availability of company resources. The guerrilla war with the computer is being won. There does appear to be a tremendous future to develop the ultimate system that integrates by use of the computer and centrally located information all functions of structure management. Again, these systems just provide the information to allow us as bridge and building professionals to make better decisions about how we care for structures critical to the operation of a railroad.

Using the computer as a tool to assist in managing our structures enables us to have more time to locate problems with our structures, determine the best maintenance or replacement option and then keep track of and budget for the work to be done.

As chairman of this special subject committee I wish to thank our sponsor, Don Sorgenfrei of Modjeski & Masters, for his help. I also wish to thank Bill Nelson from Burlington Northern's Technical Training Center for his assistance on the graphic slides. I wish to thank the committee members for the assistance they gave. As many of you realize, computer systems are treated as top secret information and it is difficult to share this information outside the company. All supplied invaluable information on the questionnaire and some included copies of articles, publications and, in some cases, copies of reports and user manuals that their system produced and used. We are available to answer your individual questions about these systems. A special thanks also goes to Dale Raaen of Andersen Consulting for his assistance in generalizing the development methodology.

Thank you for your patience. Sitting and listening to someone talking about computers can tend to be boring. Are their any questions? If not, thank you very much. (Applause)

Mr. Horney: Thank you, Don. I think that with a subject like this and the way Don presented it you can see the importance of input on these committee reports from all the different railroads to make it meaningful and worthwhile. Again, I encourage all of you on future committee reports to share your information to the committee and help us out.

The next item on our program is a special feature and will be introduced by Mark Walbrun.

Mr. Walbrun: Thanks, John. The next item on our program is a special feature and is an introduction of an inspection of welded steel bridges by Ron Purvis of Wilbur Smith Associates. Ron is a registered professional engineer in five states with 29 years of experience in highway and bridge engineering. He has been personally involved in the inspection of several thousand bridges in fifteen states. He has developed and taught training courses on bridge inspection, rehabilitation and maintenance. Currently he is a director of the structures department of Wilbur Smith Associates in Falls Church, Virginia. Ron.

INSPECTION OF WELDED STEEL BRIDGES

Ron Purvis

Wilbur Smith Associates

Background

National Bridge Inspection Program

The National Bridge Inspection Standards (NBIS) administered by the United States Department of Transportation, Federal Highway Administration (FHWA) are almost 20 years old. It is the law that all highway bridges open to the public must be inspected at two year intervals for safety. Bridges with restricted capacity or certain structural problems are normally inspected more frequently. Some agencies require that the inspector be a registered professional engineer. Minimum requirements are that the team leader have five years of related experience and successfully complete a training course.

Quality Inspection

In most situations the only means available to detect flaws in a bridge member is visual inspection. It is important to identify the flaws early in the typical crack development scenario. If the defect is identified as soon as it can be seen by the inspector, the service life of the member often has been reduced by more than 80 percent. Fractures have occurred on bridges that have been open to traffic relatively short periods of time. On such a structure, there may be only one opportunity for the inspector to identify the flaw and prevent the fracture. If the fracture will cause a sudden failure of all or part of the bridge, it is extremely important that the defect be identified in time to prevent possible catastrophe.

The flaw is often very small. The inspector has to be up close to know were to look and to recognize the crack when it first becomes visible. A supplement to the FHWA Bridge Inspector's Training Manual has been developed along with a two-day advance training course to provide instructions in this area. The manual and course were developed by Byrd, Tallamy, MacDonald and Lewis Division of Wilbur Smith Associates, Consulting Engineers, under the sponsorship of the FHWA. The course has been available since the beginning of the year; and judging by the initial response it promises to be one of the most popular bridge related courses FHWA has presented. It is scheduled by the National Highway Institute.

Identifying Fracture Critical Bridges

Definition of a Fracture Critical Member

A fracture critical bridge must have one or more fracture critical members (FCM's). A FCM is a tension member or component whose failure will produce a sudden collapse of the structure. The training course is developed on a level to include the non-engineer inspector, therefore, the theory is presented accordingly.

The participant is taught how to identify a tension member and to determine if its failure will result in an immediate bridge failure. The portion of a member in tension is being pulled apart. This causes cracks to grow and a fracture to occur. A member in axial tension is stressed the same throughout the cross section for the total length between connections. Hangers, suspension cables and some truss members normally are stressed in axial tension. The stress varies throughout members which are in bending. The inspector must be aware of tension zones in such members. For example, on a simple beam maximum tension is in the bottom flange at midspan. An equally important location on a continuous span is the top flange over the support. High stress may also be concentrated at locations along a member where the cross section changes or where there is a discontinuity.

Redundancy

For the inspector to determine if a sudden collapse will occur when a member fractures, it is necessary to understand the term redundancy as it applies to primary bridge members or connections. Redundancy is the ability of other members to help carry the load when a member becomes weak or fails. Three different types of redundancy are possible depending upon the design. The types are load path, structural and internal.

Load path redundancy relates to the minimum number of members required to support the deck under traffic. A bridge with less than three girders or trusses is considered non-redundant and therefore, fracture critical. Bridges with three or more girders are considered redundant, because if one girder becomes weak the others will help carry the load. There are degrees of redundancy that should be considered depending on the girder spacing, stiffness of the deck and framing system. A capacity analysis by a structural engineer may be necessary to predict the failure scenario on some bridges.

Structural redundancy relates to the support provided by the cantilever created after a continuous member is weakened. This occurs only on interior spans with members continuous across supports on both ends. There must be a minimum of three continuous spans to have a structurally redundant span which is located in the center.

Internal redundancy relates to crack propagation through the cross section of a member. Many members are composed of several parts. A crack must re-initiate in each part on internally redundant members. Built-up members with plates attached by rivets or bolts have internal redundancy. Others are reinforced concrete, cables, and members composed of several separate sections. Rolled steel members have no internal redundancy; nor do built-up welded members. As we study fatigue and fracture of steel members we find that cracks not only propagate freely through welds, they often initiate because of the weld.

Many agencies define FCMs in terms of load path redundancy, however, structural and internal redundancy is also considered in evaluating problems. Examples of fracture critical spans are spans supported by two or less single web girders, box girders, trusses, suspension cables, cross girders, caps, and tie members on tied arch spans. Spans supported by four or less pin and hanger assemblies also qualify.

Fatigue and Fracture

Predicting Fracture

It is very important that the inspector identify a crack or flaw before the member fractures. Physical characteristics make certain members more susceptible to fracture. The magnitude of the total stress and/or the number of times a member is stressed contribute to the fracture. Also design details have an important influence on crack initiation. The remaining factor is flaws in the member. The inspector's efficiency at identifying FCM problems is significantly enhanced by an understanding of fatigue and fracture.

Fractures require a driving force. Normally this force is produced by the loan on the structure. The force on a particular cross section of the member is called stress. The stress may take the form of compression, tension, or shear. Compression squeezes or pushes down on a member. Cracks normally do not cause problems in compression members since the material is not being pulled apart. If a crack exists in a compression member (which is rare) there is no force to make it grow. Tension stretches or pulls a member apart. Cracks are of concern in direction of the tension stress. Shear is similar to tension but rather than pull the member apart it tends to tear or slice the material. Some cracks grow as a result of shear. The direction of a shear crack is at a 45 degree angle to the force. Bridge members may be subjected to only one or a combination of these stresses.

The fracture may be the result of an overload where the member is stressed beyond its capacity or yield point. This rarely occurs on bridges designed to carry standard legal loads. More often cracks are caused by repeated loads that do not exceed the legal limit. Fatigue is the term used to describe the process of material damage due to repeated loads. One load is a cycle. A cycle must subject the member to a certain magnitude change in stress or stress range before it is significant in causing fatigue cracks. Bridges that carry a large volume of heavy loads are more likely to experience fatigue problems.

Fatigue crack initiation is not only related to the number and size of the stress cycle, it is also related to design details. Stress concentrates at locations where the rigidity of the member changes. Fatigue occurs at points of stress concentration. Details that cause changes in the rigidity of the member have been categorized to help the designer avoid cracking problems. These categories are used by the inspector to predict crack initiation in existing bridges.

All bridge members have flaws. Their size and location influence crack initiation and propagation. Flaws provide a focus of crack initiation. It may be in the base metal of the member or in the weld metal. Many flaws are not visible. Non-destructive testing (NDT) is used to identify these flaws during the shop inspection. On older bridges, NDT was now always required. Field welds and repair welds often do not receive NDT. Flaws in the base metal may be caused by fabrication, transportation, erection, or in-service damage. Such flaws include bolt and rivet holes, notches, grinding marks, copes and flame cuts. Service flaws would include collision damage, damage from improper straightening or section loss caused by corrosion.

Material Consideration

There are two types of fracture: ductile and brittle. When ductile fracture occurs, the material stretches before it separates i two parts. The fracture is slow and often there is time to prevent a disaster. A brittle fracture occurs very rapidly. The brittle fracture is of particular concern to the bridge inspector. Certain members are more likely to fail by brittle fracture. Members composed of thick plates are more likely to have a brittle fracture than members made of thinner plates. They tend to break rather than bend. Also the colder the temperature the more likely the occurrence of a brittle fracture. The tougher the steel the less likely it is to fracture. Bridges designed today contain steel meeting minimum toughness specifications. Older bridges, however, were not required to meet these specifications, but they can be tested to determine the steel toughness. Information regarding the steel toughness is of benefit to the inspector in predicting potential problems.

Design Consideration

Fatigue cracks initiate at locations in steel members where the rigidity of the member changes. These locations are created by designers attempting to save material. Cover plates are added to beams to avoid using a large size. Stiffeners permit the use of very thin webs on members. As the member bends under a load, stress is concentrated at areas where the rigidity in the member changes. Cracks initiate at these locations.

Fatigue cracks may be a result of either in-plane or out-of-plane bending. In-plane bending is a result of load distributed from the floor directly to the member. Out-of-plane bending is usually the result of the load being transferred to the member through secondary members. This force tends to twist the member, and may be transmitted into thin parts of the members, such as the web that was not designed to resist the stress. A crack may initiate in the web in the space between the connecting plate or stiffener and the flange. Often the crack is not perpendicular to the primary stress, therefore it does not represent as immediate a problem as the crack caused by in-plane bending. Inspectors, however, are cautioned to bring any cracks to the attention of a qualified structural engineer for evaluation.

Loads on the Structure

Another factor that influences whether the fracture is brittle or ductile is the loading rate. Static loading is least likely to produce brittle fracture, whereas dynamic loading often results in a brittle or sudden fracture. Bridges experience a combination of static and dynamic loading. Inspectors should be aware of situations where the dynamic loading is exceptionally high. Examples are bridges that receive heavy pounding loads. Low approaches or poor vertical alignment might cause this.

Fatigue cracking is caused by repeated loads that produce stress cycles. Larger loads create stress cycles that cause fatigue damage. A certain design detail may be capable of carrying a limited number of stress cycles that are created by the larger loads using the structure. When the number of cycles exceed the limit, cracking occurs at predictable locations. The inspector should have knowledge about the loading history of a bridge prior to the evaluation.

Crack Initiation and Propagation

Most cracks in steel bridges occur at predictable locations. Cracks occur at areas of stress concentration. They normally originate at a flaw. The flaw is often associated with a weld. When a fatigue crack caused by in-plane bending grows to a size visible to the inspector, at least 80 percent of the service life of the member has already expired. The small crack has been growing beneath the surface in a semi-elliptical pattern. After the crack reaches the surface it must penetrate through the paint before it is visible to the inspector. Occasionally the visibility is accentuated by rust stains that are associated with the crack.

NDT is available to help verify the existence of a crack. After the crack has been found these tests will locate its boundaries and measure the size. NDT is, however, not very effective in general inspection to find cracks that have not been identified.

Implementing a Fracture Critical Bridge Inspection Program

Modifying Existing Program

The purpose of fracture critical inspection training is to help prevent sudden bridge collapse. For the most effective use of resources the level of inspection should be appropriate to the criticality of the member. Agencies normally do not have the resources to have inspectors perform a hands-on, close-up, 360 degree inspection of all the components of all their bridges once every two years. FCMs, however, should receive this level of inspection. Certain things are necessary to implement fracture critical inspection procedures into an existing program: (1) inspectors trained for this level of inspection; (2) fracture critical members identified; (3) adequate resources budgeted; (4) plans made to implement the activities; and (5) quality control procedures included to monitor the program.

FCM Inspection Training

Many bridge inspectors are not graduate engineers. To be effective it is important that they understand where to look for problems. They should also know how to look, what to look for, and what to do if they find a potential problem. An ongoing FCM inspection training program is necessary for the required results to be achieved. Bridge inspection training must also extend beyond the classroom. Bridge inspectors normally work independently. A new inspector should demonstrate an understanding of the job prior to working alone. Certain personal traits should also be demonstrated. the job requires an attitude of perseverance and diligence. The inspector often may look at several hundred details with no problems before a flow is found. The temptation is great to take short cuts. The inspectors should be continually monitored to ensure that a proper attitude is maintained.

Identify FCM's

The inventory and condition data is stored in a file for each bridge. The file contains previous inspection reports, as-built drawings, repair and maintenance work recommended and performed, and current load rating information. It is recommended that each file be flagged to indicate if this is a fracture critical bridge. Otherwise the inspector may be at the site and ready to work before he realizes that a special level of inspection is necessary. This qualified structural engineer should identify the FCMs. At times a structural analysis may be necessary. The documentation should include critical locations and critical details. Special concerns such as prior damage and repairs should also be noted if these areas warrant special attention. Some FCM bridges are more critical than others due to number of cycles, type of details or material. The file should communicate all this relevant information so that the level of inspection is appropriate for the bridge.

Resource Requirements

Fracture critical bridge inspections are expensive if done properly. Since the inspector concentrates on critical areas where cracking is most likely to occur, this approach is the most efficient use of resources. Special equipment, such as hydraulic manlifts or platform devices may be required to access the critical areas. To supplement this equipment special manpower support and traffic control may also be required. The bridges should be studied carefully to insure that the proper resources are provided. It is also important to insure that an adequate amount of time is available for the inspection. The quality of inspection must have priority over the quantity, particularly for a fracture critical bridge. It may be helpful to combine inspection teams for optimum efficiency in using the equipment. Special equipment may also be necessary such as NDT devices, special lights, or ventilation devices particularly for closed boxed girder bridges.

Quality Control

The final consideration in implementing a fracture critical bridge inspection program is quality control. Quality control is often performed on a "hit-or-miss" basis. There is rarely a well defined program. To be useful it must consist of clearly defined procedures that result in a quantitative measurement of the quality. These procedures should be performed in a standardized fashion so that they can be compared from team to team and from year to year. Quality control should monitor overall and individual levels of conformance.

The FCM Bridge Inspection

Preparation

Fracture critical bridge inspection begins before the team arrives at the bridge. The team should study the file carefully while still in the office. It is important for each inspector to understand which members are fracture critical and where the fracture critical zones are located. The loading history is helpful. Fatigue prone details should also be identified. Records of damage to the structure due to collision or corrosion and repairs are also important. In addition to access equipment, the team may need special tools such as magnifying glasses, spotlights, or dye penetrating testing kits.

Assign Duties

When more than one person is making the inspection it is important to coordinate the activities. Considerations should be given to the skills of the individuals comprising the team. One person must be in charge. It is the team leader's responsibility to insure that duplications are minimized and that there are no omissions in inspection of FCMs. Data collection should also be coordinated so that it can be efficiently incorporated into a report.

Hands-on Inspection

A hands-on inspection should be performed on all of the FCMs. All details identified as "prone to cracking" must be checked very closely. The inspector's eye should be within 24 inches of the surface. The member is viewed from all sides and all angles. The inspector should use additional light and magnification to evaluate the member if necessary.

The inspection should begin with a general evaluation of the structure and fracture critical member. Look for things such as misalignment of spans either horizontally or vertically. Unusual movement or noise might also indicate serious problems. During the overall evaluation, inspectors should also look for distortions or damage created by traffic, flooding, etc.

After the overall evaluation each member and each detail is checked closely. The inspector focuses on tension zones of fracture critical members and fracture critical connections. Details that create stress concentration receive special attention. Examples of details that should be checked closely are:

- intermittent welds between the web and tension flange
- areas of sudden change of cross-section near the ends or cover plates
- locations of stress risers such as nicks, scars, flaws, and holes that have plug welds, irregular weld profile and areas where the base metal has been undercut
- locations where stiff bracing members of horizontal connection plates are attached to thin webs and girder flanges
- the web adjacent to a floor beam connection plate
- gusset plates, improperly coped members re-entering corners and the gap between web stiffeners and flanges
- longitudinal and vertical stiffener intersections
- longitudinal stiffeners that have been connected together with butt welds
- location of welds at gusset-transverse-web intersections
- flanges that pass through a web such as girder flange passing through a box girder pier cap
- box beam to column intersection
- eyebars

Discontinuities resulting from in-service problems are also scrutinized. Examples of these are corrosion, flaws and welded repairs. Areas where corrosion is likely to give problems are:

- under deck joints
- in the areas around scuppers and drain pipes
- under open steel grates
- on flat surfaces where debris accumulates
- on exposed surfaces of fascia members
- on steel in contact with concrete
- at overlapping steel plates
- at corners of steel angles and channels

Other special details that should be given attention during the FCM inspection are:

- shear connectors in the negative moment region
- pin and hanger assemblies
- tack welds on bolted or riveted connections

- unfilled holes or holes filled with weld metal
- field welds in tension zones
- suspicious attachments make tension zones such as utility attachments

FCM Inspection Report

By definition fracture critical bridges are prone to failure which may result in a catastrophe. It is important that the inspection of a fracture critical bridge be documented thoroughly and accurately. This should include a narrative description of all FCMs whether there are serious problems are not. Photographs and sketches should be included. Where there are many details and findings, tables and charts are also necessary. The data should be organized and cross referenced for efficiency in interpreting the report. The report should provide information on why problems occurred. Repairs are likely not to be effective unless they begin with the cause of the problem. The report should also include conclusions and a summary of the findings.

Along with communicating the existing condition, the inspection report should provide an on-going record of the condition of the bridge and verification of the thoroughness of the inspection activities. Bridges are unquestionably safer because they are inspected. Most deficiencies are identified and appropriate remedial actions taken. Occasionally there will be serious flaws that cannot be seen by the inspector. If a fracture occurs the report can be used to verify that a proper inspection was made.

What to do if a Flaw or Crack is Found

It would be very difficult to defend a situation where a bridge failed after the defect had been identified. It is, therefore, very important that the inspector communicates the findings in a timely manner. Ordinarily the inspector would prepare the report and forward it to a supervisor for review. If the supervisor is busy this may take a week or more. Flaws on fracture critical members should not wait that long for evaluation by an engineer. Some flaws such as a visible crack in a tension flange of a two girder bridge should be reported immediately. The inspector should go to a phone and call a supervisor. The agency should have an approved procedure for immediate closure if this is warranted. Other problems such as a flaw in a web may be reported when the inspector returns to the office. It is better for the inspector to error on the side of safety. If there is a question about the significance of a finding, an engineer should be contacted as soon as possible.

When problems are identified it is a good idea to go back and look at similar details throughout the bridge. Often inspectors have found cracks at other locations that had already been inspected after finding the first. This demonstrates that it helps to know exactly where to look and what to look for on the other details. After a flow or crack has been identified it may be helpful to do additional evaluation with NDT such as dye penetrate, magnetic particles, ultrasonic or radiographic. Thank you for your attention. (Applause)

President Burns: Thank you, Ron, for that informative presentation. At this time we will adjourn for lunch and meet back here at 1:15 p.m.

Adjourn for lunch

TUESDAY AFTERNOON SESSION

September 18, 1990

President Burns: Welcome to the continuance of the second session of this conference. Will everyone please be seated. The attendance as of noon today is: 93 B&B; 162 Roadmasters; 151 guests; 177 Associates and 84 spouses and guests, for a total of 667.

At this time I would like to call upon Joe Lileikis, sponsor of Special Subject No. 4 to introduce our first report of the afternoon session. Joe.

Mr. Lileikis: Our next special subject is "B&B Management of Contract Projects" and will be presented by Dave Franz from KCS. Dave went to the University of Cincinnati and received his Bachelor of Science in civil engineering in 1976 and is a registered professional engineer with the State of Wisconsin. In 1976 Dave went to work for the Milwaukee Road as a system bridge inspector, headquartered in Chicago and worked for them for about ten years. During the course of his stint with the Milwaukee Road he worked with the coordination of materials and procurement of materials for most of their movable spans. He decided to test the waters in 1986 with the consulting industry and went to work for Envirodyne Engineers here in Chicago as a structural engineer and project manager on various railroad projects. In March, 1989, he went to work as as bridge engineer for the Kansas City Southern and is presently employed there at this time. Dave.

SPECIAL SUBJECT NO. 4

B&B Management of Contract Projects

Chairman: D. K. Franz, Bridge Engr., KCS, Kansas City MO

Committee: R. Cacchiotti, CN, Montreal QUE
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The subject of today's discussion is B&B Management of Contract Projects. Today's B&B supervisor finds himself responsible for managing numerous and varied contract projects. Just as a brief overview, we will look first at the type of work being contracted by railroads. I will also touch briefly on the selection of a contractor, contract format, and how these relate to construction management. This discussion is based on how several railroads are managing projects once the contract is signed and the work is ready to get underway. Finally, several contractors' thoughts on working for railroads will be brought to light.

What kind of work are railroads contracting out? Well, just about anything you can think of. Typical building related projects include: new building construction, major rehabilitation, environmental/pollution control facilities, mechanical and electrical facilities, roofing work, tuckpointing, asbestos removal, and demolition projects. On the bridge and culvert side of the story are: bridge and span replacements, major steel repairs, concrete repairs, (such as pressure grouting and epoxy injection), gunnite repairs, treatment and restoration of timber structures, inspection/evaluation services, jacking and boring pipes, and pressure cleaning of sewers and culverts.

What all this means is that today's B&B supervisors are not only responsible for supervising their own work crews but must also be able to effectively manage contract labor in many different forms. We will now examine the steps and problems involved in contract work and see how railroads are dealing with them.

Although it is not the intent of this report to do an in-depth study of bidding procedures and types of contracts, it is important for the construction manager to be aware of how the job was bid, what the basis of payment will be, and how these items will affect the management task at hand.

There are three ways in which contractors can be selected for a construction project: open bidding, competitive bidding with a pre-approved bid list, or outright selection of a contractor. Which method of selection is used will depend on company or agency policy as well as requirements of the funding agency when outside money is involved.

Open Bidding

Open bidding consists of a public advertisement in whatever media is most likely to bring the message to the greatest number of potential bidders and is normally required on projects where public funds are being utilized. Due to the competitive nature of the construction industry a contractor may lowball his bid to get the job, while anticipating lots of extra costs due to change orders. There is also the possibility of ending up with a contractor who is not responsive to the railroad's needs. As we all know, any type of work which affects train operations is critical and a contractor who is aware of the problems of working with railroads can be a real asset. When managing a project that is open to any and all bidders, the construction supervisor must be intimately familiar with the contract documents and should anticipate a very high level of involvement in the project. He also better hope that the design staff turned out an airtight set of construction documents.

Competitive Bidding

More commonly found in railroad work is competitive bidding among a group of bidders pre-approved by the railroad. The advantages offered by this method includes the potential cost savings of a competitive bid situation as well as the added degree of confidence in working with contractors that the railroad is comfortable with. The requirements are still the same, however. You must have detailed plans and specs that are clear and concise.

Contractor Selection

Outright selection of a contractor with negotiated terms is the other option available to the railroad. This allows selection of the contractor that the railroad feels is the best for the job. In this instance, it is very often the case that the construction manager will be somewhat less concerned with quality control but will still need to monitor costs depending on the type of contract.

There are also three basic types of construction contracts: lump sum, unit price, and cost plus or time and material.

Lump Sum

In a lump sum contract, the contractor agrees to perform the work for a lump sum payment. With this type of contract, the construction manager does not have to spend a lot of time measuring quantities and can concentrate on quality control and other tasks. This type of contract can become a problem, however, when the amount of work is not clear when the job is bid. Jobs that don't lend themselves well to lump sum include: difficult foundation work, excavation in rocky terrain, and emergencies.

Unit Price

Another common type of contract is a unit price contract where the work is broken down into specific items of work with measurable units. The contractor provides a unit price that will apply to each pay item, and payment is made based upon the number of units that actually go into the project. It is incumbent upon the construction manager to keep close track of quantities as this will determine the final actual price of the project.

Cost Plus or Time and Material

This format is almost always used on emergency work where plans and quantities cannot be developed. Material, equipment, labor, transportation, etc. are included in the cost breakdown. Once again, detailed records must be kept to verify quantities for billing.

Given all of the above, what level of inspection and record keeping is required on any job will depend largely on the comfort level the railroad has with any particular contractor. All this having been said, let's move on to the management of the contract once the project is ready to begin.

A large part of the construction manager's work occurs before the first shovel of dirt is moved. This includes the preconstruction meeting and several associated activities. The first task at the preconstruction meeting is to establish clear lines of authority and communication for all parties involved. On a railroad project, the operating and transportation departments should always be represented at this meeting to discuss their requirements for train movements. It is also wise to have people from the various maintenance of way disciplines such as signals and communications, track, and so on so that the work can be effectively coordinated. An organization chart showing all key personnel and telephone numbers is very beneficial. Everyone needs to know who is making what decisions.

All contractors' insurance certificates should be in order. These may include: general liability, automotive and vehicle, workman's compensation, and any other insurance required by the contract documents including performance bonds.

On larger jobs there may be several subcontractors involved. It is the construction manager's responsibility to review the list of subs and be sure that they are qualified to meet a reasonable standard of performance. This may involve checking references or meeting with the subcontractor. Very often, when there is a track work sub involved, it is good to have the roadmaster or his representative check the qualifications of this sub, and the equipment he is proposing to use, to be sure that the track work can be done in the time allotted.

On some jobs, scheduling is of major importance. It is often required on larger projects that the contractor submit a CPM or PERT type schedule which will show all the tasks involved in the project and highlight those that are critical to the schedule. It is important that the schedule allows not only for construction activities but also other related activities such as shop drawing preparation and review, lead times for material fabrication and transit, etc. It is not at all uncommon for the railroad to be responsible for the supply of certain materials and the construction manager must be very cognizant of how these materials fit into the schedule. This is of particular importance in contracts which have liquidated damage clauses. When the contractor is on a tight schedule, the failure of the railroad to supply materials such as turnouts, rail, etc., can be very costly.

Another area of concern on the front end of a job is permits, fees, and licenses. Railroads have different philosophies on whether it is better to handle much of this inhouse or let the contractor do it. Many roads prefer to handle this task themselves because it allows them to keep better control of the project and foresee problems that may arise. Other roads prefer to have the contractor secure the permits since this can be a time consuming exercise. Some permits, such as temporary obstruction of a navigation channel during bridge repairs or street closures for building construction, require advance planning and are best handled by the owner. Some localities require the contractor to secure his or her own permits for certain work and the construction manager needs to be aware of this up front. It should be stated clearly in the contract documents who is responsible for what permits, licenses, and fees.

On railroad right-of-way it is the construction manager's responsibility to make every effort to locate all available information regarding utilities, etc. It is often the case on certain railroad projects that even the existence of utilities is unknown, much less their location. The manager must try to minimize the possible ramifications of working around unknown utilities. One good example is construction activities in old railroad yards which are typically full of pipelines which are not shown on any plans. Many of these old pipelines serviced buildings which have long since been removed but, rather than capping the lines at the main, they were stubbed at the service end leaving a live water line waiting for a friendly backhoe or excavator to find them. Several sophisticated methods are available for locating such utilities. In some locations, where subsurface work or excavation must be done with track out of service, it is very worthwhile to do preliminary investigation to try and locate these utilities.

Another preconstruction function on some jobs is the development of a construction site plan. In areas where space is often at a premium, a well conceived plan showing staging areas, storage areas, access routes, and the like can save a lot of headaches later. Since railroads run in a lot of remote locations, and non-rail access more often than not requires access across private property, this problem should be addressed early. Property and easement acquisition can be very time consuming.

The contractor should provide a schedule of values at the preconstruction meeting. If not, the construction manager must be sure this schedule is in place prior to the first pay request. The schedule of values consists of a breakdown of work for the general contractor and each of his subs with a dollar value assigned to each. This will allow the construction manager to ensure that the pay requests correspond to the actual value of work completed.

When the construction begins, the manager needs to set up a correspondence system that will effectively handle the anticipated paperwork. This system should include a method for controlled distribution and a filing system that allows easy recovery of documents.

Although a lot of the requirements for work around trains are likely spelled out in the contract documents, the construction manager should be sure to explain carefully to the contractor the need to execute this work in the allotted work window and to work safely around trains. The concept of opening and closing up work to allow the passage of trains may be new to the contractor, and each road has its own unique requirements. The construction manager needs to make arrangements for flagging when work is being performed on or near live tracks. Most railroads require that the flagman be a railroad employee with cost reimbursements by the contractor. It is a benefit to have a flagman who is familiar with the type of work going on as he is better able to make judgments that will minimize train disruptions and maximize work windows. Related to flagging is the whole issue of safety. As the railroad's representative on a job, it is the construction manager's responsibility to ensure to the best of his ability that safe work practices are being employed.

B&B supervisors are used to supervising their own forces and while this experience can be helpful, they must recognize the contractor's responsibilities and not interfere. Contractor's responsibilities are:

- To carry out the work in accordance with the contract documents
- To supervise assembly and installation of all materials
- To determine the means, methods, techniques, and sequence necessary to complete the work
- To adhere to all local, state, and federal laws and/or regulations affecting the work
- To administer and implement safety precautions and programs
- To complete the project within the specified time allotted for the work

That last one is tough to swallow when the track is out of service, even if there are liquidated damages in the contract. When a B&B supervisor requests changes by the contractor or stops work, except when the safe passage of trains is in doubt, it could prove to be very costly to the railroad.

Certainly one of the primary functions of the construction manager is to ensure that the work progresses and is in accordance with the contract documents. Just what level of involvement the manager has in this process may depend largely on the project structure.

For a project that was designed totally inhouse, the construction manager has the most latitude to interpret and administer the contract. Under this arrangement the owner is the designer, inspector, and administrator of the contract and the contractor, as the outside party, is vulnerable to unfair interpretation of the contract. As the construction manager, it is extremely important to maintain a fair and unbiased approach to the administration of the contract. As part of this effort, the manager should follow the standards of acceptability for all materials and workmanship established within the contract documents. Don't deviate or be arbitrary. Don't ask for more work unless you are willing to pay for it. When working with railroad forces a B&B supervisor is used to making field modifications or changes as he sees fit. The contractor's bid price is based on a clearly defined scope of work and adding a few yards of concrete here and some dirt work there will cost more and the contractor has every right to be compensated.

In the case where a consultant designed the project and the railroad is handling the construction management, it is imperative that the work adheres as closely as possible to the original design. Changes to the original design made by the construction manager may ultimately relieve the design consultant from any subsequent failure of the work due to changes made without his consent. The construction manager should not implement any changes in the work unless that change has been previously approved by the design consultant.

When a consultant handles both the design and construction administration, the owner's inhouse construction manager must work through the design consultant who is now acting as the agent of the owner. Two important limitations in the responsibility of the design consultant are that he cannot stop the work (only the owner may take this action) and the design consultant is not responsible for the contractor's failure to carry out the work in accordance with the contract documents.

Another important function of the construction manager is documentation, especially of items or events that are contested by either party to the contract. Work which is not in conformance with the contract documents should be rejected. Be sure that you properly document the reasons for rejection of the work and it is based on the standards of acceptability established in the contract documents. Any design changes must be properly documented to avoid any future problems which may result as a consequence of that change. If a consultant is managing the contract, observation of work which is not in conformance with the contract documents should be brought to the immediate attention of the design consultant, not the contractor.

Occasionally the construction manager may be put in the difficult position of stopping the work due to non-conformance with the contract documents or negligent work by the contractor. This is a major decision on any project and must be properly handled. The contractor must be afforded proper warning prior to taking this action and must be given ample time to correct the problems.

The construction manager must review all contractor proposals for changes in the work. Changes may add to or decrease the cost of the project and may require negotiations. Owner-initiated changes should have prior design consultant approval where applicable. Contractor initiatives should be approved by the design consultant and owner. If the change is acceptable to all parties, contract modifications should be prepared for the owner's signature and a signed copy given to the contractor. When a change order involves a significant increase in cost, the construction manager must be sure that the bonding agent is notified so that the additional work is covered.

In addition to the just discussed item, there are numerous other tasks that must be performed to successfully manage a project. The level of detail and frequency of these tasks will vary depending on the nature of the project and the relationship between the railroad and the contractor. Some of the other tasks are as follows:

- Progress Reports — While these are handled on a weekly basis on some roads, the majority prefer a daily report of activity. These reports normally indicate manpower, weather, progress in reporting period, heavy equipment on site, deliveries, etc.
- Records of material shipments may be required including date arrived; shipper and receiver; quantity, description, and condition; and file receipts. On jobs that include material supplied by the railroad, these records should also be carefully kept for such material including both the date material is requested by the contractor and the actual arrival date.
- All shop drawings should be processed through the construction manager. He should be sure that the contractor has reviewed and approved shop drawings prior to review by the railroad. The manager must also make sure that shop drawings are moved along in a timely fashion. Depending on the nature of the project, this may include moving the shop drawings through numerous railroad departments.
- Testing agencies used on the project must be observed to guarantee that the services being provided meet the railroad's needs.
- The field drawings must be regularly updated to reflect the as-built condition of the facility or structure. This is of particular importance in railroad structures since they are often called upon to live long lives and may receive many modifications along the way.
- Some survey work may be required to confirm the construction layout work being performed by the contractor. Most railroads find this task to be very important in track related work since track work in the field is often not as shown on the plans.

Most railroads represented in this report require weekly or bi-weekly progress meetings with the contractor. Designers, suppliers, subcontractors, and affected railroad departments should also attend this meeting as necessary. The purpose of this meeting is to resolve problems that may arise, review work that has been completed, and look ahead to the upcoming work. This is also a good time to review the schedule. The schedule needs to be revised and monitored during the course of the project if it is to be of any value.

Payment on large projects for most railroads is made monthly. The contractor submits a pay request with backup data for review and approval by the owner. This pay request should be based on the schedule of values set up at the beginning of the project. To expedite this process, the construction manager should make a thorough site inspection just before each pay request is due to verify the work that has been completed. Contractors will often ask for payment for stored materials. This is a legitimate request, but if the material is not stored on site, the construction manager should check that the material actually is on hand at some location, that it is clearly marked as sold to the railroad, and get an affidavit assuring that proper precautions will be taken to prevent misplacement of the material. The actual value of stored material is often called out in the construction documents. It is important that payments reflect quite accurately the actual dollar value of the work that has been done. If, for example, on a million dollar job a contractor goes under and has been paid $600,000 for $400,000 worth of work, then $600,000 will still be required to finish the job and the total cost will now be $1.2 million. In order to protect against liens being placed on the property, it is good practice for the construction manager to obtain waivers from the contractor for the total compensation received to date as well as an affidavit that all subs and suppliers have been paid to date.

It is very important for the construction manager to keep very detailed accounts of any accidents or injuries which occur on the construction site whether it be to a railroad or a contractor employee. You should get the names of as many witnesses as possible and follow the procedures set down by the railroad.

Many of the problems encountered on most construction projects have their origin in the design and engineering phase of the project and the construction manager must be prepared to address these problems in a fair and unbiased manner. Proper documentation and record keeping is essential on any project regardless of size.

When the contractor is ready to turn the project area over to the railroad, a notice of substantial completion should be sent to the construction manager. A pre-final walk through, including a punch list made of items that need to be corrected, should be made. Testing and balancing of mechanical systems also needs to be verified and required documents in place. Most railroads use a 10 percent maximum retention of payment, but the number is often reduced as the remaining value of work decreases.

Prior to the final inspection and acceptance of the work, the construction manager must receive the following from the contractor: guarantees and warranties, shop drawings/as-builts, operating instructions and manuals, and maintenance parts if that applies.

If the final inspection finds all work to be acceptable, the contractor's final application for payment should be processed. The construction manager should also receive all final waivers of lien at this time.

In talking to contractor representatives, there are several items that come up relating to railroad work. Many complaints are related to the bidding and letting of contracts which is out of our scope here today, but there are several comments/suggestions which are pertinent. One comment is that railroads often don't check a job to make sure that the contractor is providing the supervision and quality of work promised. Good contractors feel this opens the door to abuse and allows a few bad contractors to give many a bad name that is ill-deserved. It is also noted that many railroad construction supervisors do not really know what to look for on some projects.

What contractors typically see are periodic inspections by railroad supervisors. They feel that heavy inspection should be utilized up front and then reduced as the comfort level grows. The one major complaint is that it is difficult to get clear-cut approval from the railroads when decisions need to be made. This relates back to the organizational chart we talked about earlier. There should be clear cut lines of authority.

Of course, we could also talk about the complaints railroads have about contractors, but that might require a two-day conference by itself so we won't get into that.

In closing, you can be pretty tough or pretty relaxed with a contractor but the most important thing is to be consistent and fair. I suspect that would apply in most of our endeavors. Thank you. (Applause)

President Burns: Thank you very much, Dave. You're right, it is very timely and we seem to be getting into more and more contract work all the time, especially in specialized areas. Now I would like to call upon Ray Tallent, our immediate past president to introduce all past presidents who are in attendance today. Ray.

INTRODUCTION OF PAST PRESIDENTS

Mr. Tallent: As I call the names of the past presidents today I would like them to stand and remain standing until all have been called. Jack Williams, vice president, Alfred Benesch, president in 1975-1976; Jerry Iwinski, structural engineer (retired), Chicago. North Western Transportation Co., president 1977-1978; Wally Sturm, senior project engineer, Elgin, Joliet and Eastern Railway, president 1978-1979; Jim Budzileni, retired senior structural designer, Illinois Central Railroad, president 1983-1984; Jim Williams, supervisor B&B (retired), Elgin, Joliet and Eastern Railway, president 1984-1985; John Kapp, system engineer, Conrail, president 1986-1987; Don Lewis, bridge construction engineer, Illinois Central Railroad, president 1987-1988; and I am also a member of this esteemed group. (Applause)

President Burns: Thank you, Ray. On behalf of the Association I thank all of you for being present. We appreciate your past service and continued interest in the Bridge and Building Association.

As past president and chairman of the Nominating Committee, Ray will now present the slate of candidates recommended for consideration as officers. Ray.

L to R: **J.R. Williams; J.R. Iwinski; W.C. Sturm; D.J. Lewis; R.A. Tallent; J.T. Kapp; J.M. Williams; J. Budzileni.**

NOMINATING COMMITTEE

Mr. Tallent: Thank you, Byron. The nominees are as follows: for president, John Horney, bridge engineer, Union Pacific Railroad; for senior vice president, Mark Walbrun, project manager-Chicago Union Station, Amtrak; for junior vice presidents, Paul Saletnik, engineer of buildings, Chicago and North Western Transportation Company, and William Nelson, manager maintenance-of-way training, Burlington Northern. For directors whose terms will expire in 1993: Don McCammon, manager bridge and buildings, Burlington Northern Railroad; John Creighton, bridge and building master, Canadian Pacific Rail; and, Johnny Bradley, division engineer-bridges, Norfolk Southern Corporation. This is the slate of nominees. Thank you.

President Burns: Thank you, Ray. All of you heard the slate of nominees recommended by the Nominating Committee. There being no other nominees, I will accept a motion that the slate submitted be elected. Do I have a motion?

Member: So moved.

President Burns: Is there a second?

Member: I second.

President Burns: The motion has been made and seconded that the slate of candidates recommended by the Nominating Committee be elected to the offices specified. All in favor signify by aye.

Membership: Aye (in unison).

President Burns: Those opposed signify by nay. The ayes have it. I hereby declare these officers duly elected. (Applause)

I'll turn this back to Ray. He has one more duty to perform. Ray.

Mr. Tallent: One of my duties is to fill vacancies that occur in the Honorary membership category. As you know, three of our honorary members passed away during this past year: Merwin Dick, J. A. Jorlett, and Gene Schlaff. The candidates selected to replace our deceased members are: Frank Richter, publisher of Progressive Railroading and a leading supporter of all railroad groups. Frank has been around a number of years and I think we all know and have benefited from Frank's knowledge of the railroad industry. Next is Walt Hyma. Walt is retired bridge engineer systems from the Santa Fe Railway and served as our president during the 1981-1982 year. Joe Chambers is retired bridge construction engineer on the Missouri Pacific and our president during the 1980-1981 year. I would like a motion to appoint these worthy gentlemen to the status of Honorary membership.

Member: I so move.

Mr. Tallent: I have a motion. May I have a second?

Member: I second.

Mr. Tallent: The motion has been made and seconded. All those in favor say aye.

Membership: Aye (in unison).

Mr. Tallent: Those opposed? They ayes have it. These three gentlemen are recognized as Honorary members.

President Burns: At this time I would like to present a constitutional change to you for a vote. All members received a copy of the proposed new constitution for the American Railway Bridge and Building Association with the last newsletter. As I indicated in my letter in the newsletter, as our organization approaches its 100th anniversary, we felt it was time for several changes in our constitution for a number of reasons. Among these were to clarify classes of membership. Another reason was to bring the document up-to-date in wording and meaning and make sure it was consistent with the operation of the organization. I know all of you have had time to review the document. At this time I would like to request that a motion to accept the proposed constitution as submitted.

Member: So moved.

President Burns: Is there a second?

Member: I second.

President Burns: I would like to now ask if there is any discussion from the floor? There being no discussion from the floor I would like to ask that all in favor of the motion signify by saying aye.

Membership: Aye (in unison)

President Burns: Any opposed? The motion is carried. The new constitution has been accepted by the membership and is in effect as of September 18, 1990.

We will now proceed with the rest of our business session and provide the necessary reports. If there are any questions concerning any one of the reports, I request that you hold your questions until after the report has been given. Will our secretary, Pat Weissmann, please give the Secretary's report. Pat.

BUSINESS SESSION

MEMBERSHIP REPORT

September 1, 1989 Through August 31, 1990

Total members, September 1, 1989		716
New members since September 1		58
Members reinstated since September 1		2
		776
Less: Dropped — Active	29	
Associate	5	
Life	2	
Deceased — Life	7	
Honorary	3	46
Total members, August 31, 1990		730

President Burns: Thank you, Pat. I would like to add that that 730 is a number I consider very good considering the downsizing that is happening in all our railroads. It's consistent with the membership level of several years ago.

Will Jim Williams please give the Treasurer's Report. Jim.

TREASURER'S CASH REPORT

September 1, 1989 Through August 31, 1990

Checking account balance, September 1, 1989		$ 6,097.85
RECEIPTS		
Dues	$ 9,240.00	
Advertising — 1988	1,000.00	
1989	13,652.76	
1989 Conference proceeds	26,367.00	
Interest on checking account	437.36	
Transfer of funds from savings	4,000.00	
Miscellaneous	740.00	55,437.12
		61,534.97
DISBURSEMENTS		
Salaries	$ 9,439.39	
Payroll taxes	1,071.44	
Employee savings	373.26	
Office rent, utilities & insurance	1,878.09	
Office supplies	291.86	
Equipment purchase, rent & repair	743.90	
Stationery & printing	1,685.12	
Postage	1,500.00	
1989 conference expenses	740.52	
Temporary office help & consultants	518.00	
1989 advertising	151.75	
1989 Proceedings	9,948.15	
Executive Committee meetings	2,016.65	
Duplicate dues refund	20.00	
Miscellaneous	257.91	
Foreign check charges	3.12	30,639.16
Transfer of funds to savings		20,000.00
		50,639.16
Checking account balance, August 31, 1990		$10,895.81
Homewood Federal S&L Money Market 10/31	$ 7,381.25	
Homewood Federal S&L Certificate 1/91	5,613.04	
Homewood Federal S&L Certificate 2/91	11,416.85	
Homewood Federal S&L Certificate 10/90	4,000.00	28,411.14
Total funds, August 31, 1990		$39,306.95

President Burns: Thank you, Jim. Jack Williams, chairman of the Auditing Committee, will present the auditor's report. Jack.

AUDITING COMMITTEE REPORT

To: Members of the American Railway Bridge and Building Association

Gentlemen:

The undersigned have examined the books of the Secretary and report of the Treasurer for the period of September 1, 1989, through August 31, 1990, and have found them to be correct as of August 31, 1990.

(signed) J. R. Williams, Chairman
(signed) W. C. Sturm
(signed) J. Budzileni

President Burns: Thank you, Jack, and we would also like to thank the committee for taking time to go to the Association headquarters to audit the books.

At this time I would like to ask Don Sorgenfrei to give the Necrology Report. Don.

NECROLOGY REPORT

To the President and members of the American Railway Bridge and Building Association:

It is with grief and regret that we report the known loss of ten members through death during the past year. It is possible that other members have passed away during the year of whom we have no information. If you know of anyone, please report their names to the Secretary. The following have been reported since our last Annual Conference in September, 1989:

M. A. Beringer
Superintendent Bridge Erection (Retired)
Illinois Central Railroad
Joined 9-1-29; Died 11-22-89

O. E. Fort
Chief Engineer (Retired)
St. Louis-San Francisco Ry
Joined 2-6-57; Died 11-20-89

William J. Hedley
Assistant Vice President (Retired)
Norfolk & Western Ry
Joined 9-17-50; Died 9-10-89

J. A. Jorlett
Structural Engineer (Retired)
Penn Central
Joined 10-17-40; Died 2-11-90

Carl C. Patterson
B&B Supervisor (Retired)
Burlington Northern RR
Joined 10-15-58; Died 8-6-89

B. L. Pritchard
Division Engineer (Retired)
Atchison Topeka & Santa Fe Ry
Joined 10-3-56; Died 12-4-89

V. D. Raessler
Supervisor B&B/WS (Retired)
Illinois Central Railroad
Joined 7-23-51; Died 11-27-89

W. H. Rainey
B&B Supervisor (Retired)
Southern Pacific Transportation Co.
Joined 10-3-56; Died 3-8-89

E. R. Schlaf
Superintendent Fire Prevention (Retired)
Illinois Central Railroad
Joined 7-2-47; Died 5-31-90

John D. Trulove
B&B Supervisor (Retired)
Southern Pacific Transportation
Joined 10-3-56; Died 3-8-89

I would like to ask for a moment of silence in honor of our deceased members.

Respectfully submitted,
Donald Sorgenfrei, Chairman

President Burns: Thank you very much, Don. Are there any questions at this time regarding any of the reports that have been given by the Secretary, Treasurer, Auditing Committee or Necrology Committee? If there are no questions or discussions I will request a motion that these reports be approved as given.

Member: So moved.

President Burns: Is there a second?

Member: Second.

President Burns: The motion has been made and seconded. All in favor signify by saying Aye.

Membership: Aye (in unison)

President Burns: Opposed? The motion is carried and the reports are approved.

Our next presentation is a panel discussion and I ask that the members of the panel join me here on the podium along with Mark Walbrun who will introduce them.

PANEL DISCUSSION

Railroad Contracts

Moderator: John J. Horney, Bridge Engineer, Union Pacific
Panelists: Thomas J. Parker, Project Manager, Envirodyne Engineers
Kenneth J. Norton, Vice President, Osmose

Mr. Walbrun: Our next presentation will be a panel discussion regarding railroad contracts, specifically the contract document itself. Every railroad has their own standard form of contract, each being unique and with possible variations as to size and type of project. The objective of this panel discussion is to present the viewpoint of a railroad, a consulting engineer, and a contractor. Our panel members are John Horney, bridge engineer with the Union Pacific Railroad; Tom Parker, project engineer with Envirodyne Engineers and Ken Norton, vice president of Osmose. I'll turn this over to John, who will start us off.

Mr. Horney: Thank you, Mark. Every railroad deals with contracts on a daily basis, either for maintenance work, new construction, or emergencies. Once the decision has been made to contract work, a Bid Package is generated and sent to appropriate contractors to review and ultimately submit their bid proposal to perform the intended work. Once a bid is accepted, a contract is formed. I will discuss the items that are important to include in a major, planned project, then briefly address smaller projects and emergency work.

The entire Bid Package is considered as part of the contract. A Bid Package includes:

- Invitation to bid
- Bid form
- Plans and specifications
- Standard form of contract

Invitation to Bid

The Invitation to Bid is basically a cover letter personally addressed to the individual contractors. It includes the project description, location, contents of the bid package, date and time the bids are due, time and location of prebid meetings, and who and how to contact the individual managing the project for questions.

Bid Form

The contractor lists his prices on the bid form and submits it as his proposal. This form can be formatted for a lump sump bid, a cost plus, or for unit prices such as mobilization, demobilization, and major components of the job. Major job components could include grading, pile driving, removal of existing structure, concrete placement, etc. Unit prices not only helps in negotiations but also defines the operating expenses and capital expenses for accounting purposes. The bid form also includes equipment costs and if there is an add or deduct if the equipment is idle.

Plans and Specifications

Very important items are included in the construction specifications. The construction specifications or general conditions are in addition to the material specifications that come from the engineers. For the contractor to be able to submit a realistic bid, he has to work on the track or bridge without train delays. If the allotted time isn't consistently available, delay charges are in order and these charges have to be spelled out. Access into and out of the project needs to be addressed and if a road needs to be graded, who builds and pays for the access. If the project requires work around a road or highway, the cost of flagging vehicle traffic needs to be addressed. Just as above, any unique problem involving the site location, utilities, appropriate permits, etc., need to be addressed in the construction specifications or you will be negotiating extra orders.

Standard Form of Contract

The standard form of contract is that all encompassing, but necessary, legal document written by the lawyers that defines the liabilities the contractor is responsible for. I believe that we all have an outstanding group of contractors that work for us. They do quality work and are in the business knowing that there will be future projects. The standard form of contract is written for that occasional contractor who, for one reason or another, may be out for everything he can get by with, from sloppy work to unsafe work, or just plain walking away from the job. Unfortunately, our respective lawyers, as well as ourselves, need to protect the railroad from just that scenario.

Pre-Bid Site Visit

On planned projects it is helpful to hold a pre-bid site visit. Before the bids are due, a visit is made to the project site. All questions are answered with the contractors present so everyone has the same information. Minutes of the site visit are then sent to the contractors so there is no misunderstanding. Also, any questions and answers handled over the phone with individual contractors are sent to all bidders so all information is equal. These minutes and notes are sent to every contractor with the stipulation that the contractor must acknowledge receipt of same on his bid form and thus becomes part of the contract.

Pre-Construction Conference

Finally, once a contract is signed, a pre-construction conference is held with all the players present to define communication channels, chain of command, emergency and safety procedures. This is where the project manager takes the ball.

Miscellaneous Contracts

The ideal process just discussed doesn't always happen. On short notice, or smaller projects, a site visit is made with the contractors to define the scope and desired results of a project. The contractors then submit their proposals including the method, scope and price of the job. These proposals need to be looked at very carefully so you are sure that you are comparing apples to apples.

For emergency work, specifically for bridges, proposals from various contractors may be kept on hand for performing zero pre-notification emergency work. These proposals include labor and equipment prices and their mark-ups for furnishing material. When an emergency occurs, contact the lowest through the highest proposal until the first contractor available is found for immediate response. You may then verbally turn them loose and usually have the contract enroute to their office before they arrive on site. These are basically the only contracts we allow for cost-plus work.

However, one exception involves maintenance work with unknown quantities involved. Estimates of quantities are made for bid purposes so all contractors have equal ground to bid on. Estimated quantities are submitted, without binding, thus establishing a unit price to pay against. Material actually used will be paid at the unit prices given.

With that overview of the items we feel are important to include in a contract, I'll pass the discussion to Tom Parker.

Mr. Parker: Thank you, John. It's quite interesting that we are going to have three perspectives of the development of a construction contract based upon an in-house (railroad) method and/or procedure. In general, much of what has already been presented is similar to how a consultant working for a railroad must approach a project given this type of assignment. However, consultants very often do not have repetitious assignments and the requirements built into a contract may and will differ by client and the type of work involved.

The development of the terms and conditions of a contract document (i.e. general conditions, special conditions, specifications and drawings) very often differ from one project to another and in many cases could differ for the same client. Each project may have unique requirements dictating deviations from a standard contract format and must be considered when developing the contract documents. The success of the project is entirely dependent on the completeness and adequacy of these documents.

As mentioned earlier, the contract documents embody four basic components. Each of these components are essential to the work and will govern not only the conduct of the work, but will also be the contract administrators guide in determining performance, payments, criteria for change order, notice of claims, insurance and any other necessities. A poorly prepared set of contract documents can be disastrous to the owner, consultant and any other party involved in the work. Therefore, a consultant must carefully prepare these documents to protect the owner's interest, limit the exposure of the consultant and provide a reasonable means for the contractor to receive fair and equitable treatment.

A set of contract documents is composed of two basic ingredients. These are the terms and conditions of the contract and the technical requirements (specifications and plans). The terms and conditions of the contract consist of four basic components as follows:

- Invitation to Bid and Instructions to Bidders
- Contractor's Proposal Form and Agreement
- General Conditions
- Special Conditions

Each of the above components serve a unique purpose and serve as a guide in administration of the contract.

Invitation to Bid and Instruction to Bidders

This is the vehicle by which the owner extends an invitation to bid to selected contractors deemed appropriate for the work. On some projects involving government funds no preselected list of contractors may be used and an advertisement for bids must be used.

An invitation to bid outlines in general terms, the work to be performed and is accompanied by the appropriate contract documents. This invitation may also outline how various segments of the work are to be quoted (lump sum and/or unit cost) and any other unique feature of the contract. The invitation to bid will also specify the exact date and time bids are to be submitted, person(s) to contact regarding questions about the work or for an appointment to visit the site. the invitation will also specify that the bidder should also advise the owner if the contractor intends to submit a bid.

An open advertisement to bid places no qualification upon the bidder and stipulates the date and time bids are due and who to contact regarding questions about the work.

Pre-bid meetings and site examinations may be established but are not necessary. These activities are options of the owner or may be arranged in the event that contractors request such meetings and/or visits prior to the bid due date.

Contractor's Proposal Form and Agreement

This document is used by the contractor to state his price for the work. The proposal form may only require a lump sum price or a combination of lump sum and unit cost dependent on the type of work to be performed. This form generally requires figures to be quoted in numbers and in words. A duly authorized officer of the contractor's organization is normally required to sign this proposal form and the form must also be notarized.

The agreement form is the contract form by which the railroad and contractor accept the terms under which the work is to be performed. This form may incorporate various portions of the general conditions which are considered most important to the railroad. This agreement form can vary significantly from railroad to railroad.

General Conditions

The general conditions serve as the basic tool in the administration of the contract. Most often the clauses contained in the general conditions are of a standard format and have been used repeatedly by the railroad in all construction contracts. For the most part these general conditions clauses have been court tested and found to withstand legal challenges over the years and have proven to protect the owner. The general conditions contain the following clauses:

- Definitions
- Order of precedence of component contract parts
- EEO Policy (optional)
- Minority Business Enterprise Requirements (optional)
- Indemnity
- Employment
- Subcontractors
- Character of workmen and equipment
- Subletting and assignment of contract funds
- Cooperation between contractors
- Permits and fees
- Work, inspection and responsibility
- Schedule of payment
- Method of payment and retention
- Changes
- Payment for changes

- Effective date of contract and notice to proceed
- Suspension of work
- Performance of work
- Termination for default
- Termination for convenience
- Disputes and claims
- No waiver of legal rights
- Compliance with laws
- Notice
- Royalties and patents
- Submittals
- Project data and records

The above items are considered basic requirements. Many of these clauses may vary in name and some may not be found in a railroad's standard boilerplate. From a consultant's point of view, if they are not all included in the standard form of general conditions then those missing clauses should be included within the special conditions.

Special Conditions

The special conditions of a contract are tailored more specifically to the conditions and type of work to be performed. The following is a list of those clauses which may be typically found in this section:

- Scope of work
- Contractors rights and responsibilities
- Description of services
- Material sampling and testing
- Materials
- Shop drawings and other data
- Samples
- Protection of persons and property
- Miscellaneous provisions (i.e. temporary services)
- Guarantees and warranties
- Schedule
- Provisions relative to delay
- Time extension
- Damage (if applicable)
- Insurance
- Performance bond

Each of the above clauses contain several subparts which outline the contractors responsibilities for providing the work and performing other essential services necessary for the project.

The general conditions in conjunction with the special conditions form the administrative guidelines necessary to perform the work and outline the specific responsibilities of the owner and contractor.

Technical Requirements

The technical requirements of a contract are provided in two forms, technical specifications and detailed design drawings.

Dependent upon the nature of the work, the technical specifications can contain 16 individual sections. These sections cover all aspects of the work from excavation to electrical. Specifications can be written for sole source materials which can be costly to the owner to open type specifications which permit more than one manufacturer/supplier to bid the work. Generally, when an open type specification is used, a minimum of three manufacturer/suppliers are referenced. Quality standards are written into each section in order to insure that at the least, a qualified manufacturer/supplier is selected. Complimenting the technical specifications is a set of detail drawings for the work. These drawings must represent the most accurate depiction of the work as is possible. They must be thoroughly coordinated and checked prior to issuance for bidding. Poorly prepared drawings and/or technical specifications can cause major problems for the consultant and owner and, as a result, lead to significant cost overruns.

It is the consultants obligation to the client to prepare a set of contract documents which will properly address not only the necessary technical requirements of the work, but the conditions under which that work must be performed.

Obtaining the services of a consultant experienced in the type of work to be performed is the first step towards a successful project.

With that, I'll turn this over to Ken Norton of Osmose.

Mr. Norton: Thank you, Tom. It has been my observation through more than 20 years of railroad contracting experience that agreements between contractors and railroads take one of the following forms:

1. Lengthy, voluminous, wordy contracts
2. Short form contracts
3. Purchase orders
4. Agreement drawn on the contractor's proposal forms

A few comments on each of these:

Purchase Orders

One might think that purchase orders are reserved for smaller projects. This does not seem to be the case. Frequently, large volumes of work are contracted using purchase orders. Seldom is it the contractor who decides to use this agreement process. It always is the railroad that dictates this procedure. Since purchase orders arrive at the contractor's office already signed by the railroad, it is a streamlined, expedient way to solve the agreement process. The contractor usually is requested to sign a copy of the purchase order and return same to the railroad.

Contractor's Agreement Forms

Proposal forms provided by the contractor usually include signature pages, whereby these proposals can be converted to an actual contract if signed by both parties. On occasion this is the way we proceed. Normally though, this process is restricted to short line and regional railroads. Very few major carriers proceed on this basis. Obviously, contractual agreements based on purchase orders and those which are drawn up on a contractor's own ''paper'' are the easiest to proceed with, if only because of the reduced wording and the related reduction in reviewing time.

Large ''Wordy'' Contracts

It's obvious the legal fraternity has had many cracks at writing and revising the long contract forms, particularly those sections dealing with and qualifying all the liability aspects of contracting various services. Many contract forms include indemnification clauses where the owner is specifically excluded from any liability involving work which a contractor might accomplish. Most contractors are not opposed at all to this. Of interest is the fact that a few agreement forms carry the indemnification situation quite a few steps further, and, in essence, state that the contractor is or may be responsible for incidents that occur on the railroad which may be far removed from our project and which he had nothing whatsoever to do with. Occasionally they even throw in the phrase, ''in perpetuity'' which means that liability for situations such as this extend forever, and beyond the term of the contract agreement. If these types of qualifications are literally interpreted, they are rather scary.

We, for example, had no problems with liability phrases such as this until such time as we acquired our own legal department. One of their earlier projects was to review contracts prior to signature, and when they reviewed some of the previously mentioned liability phrases, they dictated that contracts containing such wording should not be signed, and that we should negotiate changes. Obviously that tact would not work. It was never tried, and we simply stated that if that was going to be our approach we may very well spend all our time negotiating with railroad legal departments and force ourselves out of the contracting business. Contractors realize that we are dealing with agreement forms which have been written to attempt to cover all types of situations. Very seldom are these forms specific to individual projects, and the specifications for these projects are normally covered as addendums to the standard wording agreement. Thus, common sense must prevail regarding certain indemnification and liability statements that might be injurious to the contractor. We realize that time constraints do not allow specialized wording for each agreement railroads enter into and that these forms are a necessity.

I am reminded of one particular railroad which has voluminous requirements such as signature by our president, along with board of directors resolutions allowing individuals to sign in behalf of our firm, notorization, corporate seals, and initials on each and every page and attachment. The irony is that this agreement form normally arrives well after we have been given verbal authority to proceed. Occasionally, it even arrives after billing has been completed. So we are going through the voluminous legal motions well after the stated work has been completed. Ironic!

I cannot end my comments without stating equivocally that contracts are not a problem for most contractors. They are, after all, our objective. They are our lifeblood. Most contractors will always find a way to comply with what is required. In our case, we keep telling ourselves not to interpret much of the wording too literally. To assist in this objective, we prefer to have our engineers review contract forms rather than our legal department.

Payment Terms and Change Orders

I have been asked to also provide a few viewpoints regarding payment terms and change orders. Change orders are most often instigated by the contractor and reflect a change in the magnitude or scope of any given project. The objective is to match the contract to the actual work required along with the applicable job specs and prices. If change orders accomplish this, then they are an asset. My personal view is that change orders are frequently perceived as negative by many clients, so we attempt to anticipate potential work procedures in advance, eliminating the need for change orders. I suspect that many contractors share this same attitude.

I also have been asked to comment on payment terms. Most contractors, like everyone else, like to get paid as soon as possible after project completion and periodically throughout longer projects. . . those in excess of one month. It has been our experience that railroads are extremely pleasant to deal with when it comes to receivables. With few exceptions, all pay within 60 days of invoices and are willing to make progress payments during longer projects. This reduces the need to factor large amounts into contracts to cover receivables.

Mr. Walbrun: Thank you for sharing that information with us. As you have just found, the business of railroad contracting is quite complicated. Along with this subject, I'd like to make an important announcement at this time. The American Railway Bridge and Building Association will become more active by bringing detailed information to its membership. The Association will offer a seminar this coming spring that will deal specifically with railroad contracts. The seminar will address all the items you just heard discussed, but in greater detail, and will include examples of contract formats and procedures. It is the hope of the Association that this seminar will help bring continuity to the industry and help all of us benefit with the result. Also, if this seminar is as successful as we hope, it will be the first of many to come offering subjects of interest in the railroad industry. We will solicit your input on the types of future programs that may be of interest to you and we welcome any comments.

Our final presentation today will be on modifying pin to fixed joints on truss spans by Bob Grove of Kiewit Western and Ralph Eppehimer of Modjeski and Masters. Gentlemen.

PIN JOINTS MODIFIED TO FIXED JOINTS ON TRUSS SPANS

Ralph Eppehimer

Engineer, Modjeski and Masters

and

Robert Grove

Superintendent, Kiewit Western Co.

Mr. Eppehimer:

This presentation addresses a method of repairing worn truss member pin joints under traffic. This method was recently employed on the Thebes Bridge. Selected original pin joints of multiple primary load carrying truss members were converted to "fixed" joints by retrofitting gusset plates. First, I will introduce the bridge, its problems and the resulting development of the repair scheme by Modjeski and Masters. Then, Bob will explain how Kiewit Western Company successfully constructed the repairs.

Bridge Description

The Thebes Bridge crosses the Mississippi River from Scott City, Missouri, to Thebes, Illinois. The bridge is owned by the Southern Illinois and Missouri Bridge Company and services both the Southern Pacific Transportation

The Thebes Bridge, built from 1902 to 1905.

Truss joint repair work during 1989 and 1990.

Company and the Union Pacific Railroad. The double track railroad bridge was built during the years from 1902 to 1905. Its construction established a vital east-west link for the railroad industry at that time, and the bridge has remained an important crossing throughout its 85 years of service. Maximum present traffic volume is estimated at 45 trains crossing the structure per 24-hour period.

Ralph Modjeski and Alfred Noble were the chief engineers for design and construction of the Thebes Bridge. The bridge is 3,908.6 feet long from abutment to abutment, including its concrete arch approach spans. The main bridge superstructure is 2,750.3 feet long from Pier I to Pier VI, and consists of five spans of riveted and pinned steel through-trusses with open deck, double track floor systems. The center span (Span III) is 671 feet long, the two adjoining spans (Spans II and IV) are each 521 feet, 2 inches long, and the two shore spans (Spans I and V) are each 518 feet, 6 inches long. The depths of the trusses vary from 50 to 75 feet across the structure. The superstructure was designed as a cantilever truss system, as opposed to independent simple spans. That type of structure was chosen for economy and to enable erection of the center span, without any falsework in the river channel, by cantilevering out from the piers until the midspan connections were made to join the two halves. That method of erection would serve to keep the channel open for navigation and permit erection with any adverse river conditions, including considerable ice flows, that would threaten falsework during the winter. The channel span was erected during the winter of 1904-05.

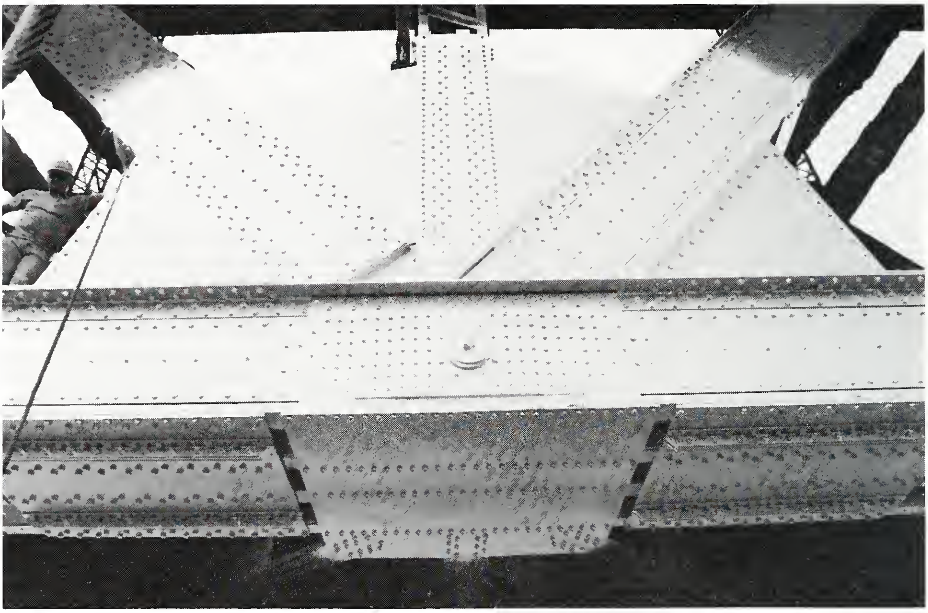
The superstructure basically consists of three types of structural units reoccurring throughout the five span structure. Those units are the fixed span, the suspended span and the cantilever arm. The channel span (Span III) is composed of a central suspended span and two cantilever arms. The shore spans (Spans I and V) each include one nearly identical suspended span and one nearly identical cantilever arm. Spans II and IV are the fixed spans and were built essentially identical.

Truss Pin Joint Wear

Periodic inspections of the bridge over the years have shown an increasing number of structural problems and defects, including wear in pinned truss joints. This wear is common in old pinned trusses and is the result of the normal cyclical loading and unloading of truss members. The wear is usually accelerated in members which undergo reversals of tension and compression loads. The contact surfaces between the pins and the member bodies wear with time to produce elongated pin holes in the member bodies and scores in the pins. The gaps formed between the bearing surfaces loosen the truss joints which then have the potential to cause many different problems. Locally, in the pin joint, pin stresses will increase due to loss of section and higher impact loads induced by the truss members as the gaps between the bearing surfaces repeatedly open and close. The looseness of the joints permits relative movement between truss members and fretting wear between adjacent components that come in contact with each other. Lateral shifting of member positions on worn pins can cause unequal distribution of loads between components of the member bodies. The worn joints reduce the overall stiffness of the trusses and cause the truss geometry to change significantly under traffic. The loss of truss stiffness and changing truss geometry increases deflection and distortion of the spans, which raises stresses in the floor system, truss lateral braces and sway frames. Therefore, the effects of worn truss joints can be widespread. The rate of wear and general structural deterioration tends to increase with time and usage.

Truss Joint Repair Method

The railroad engaged Modjeski and Masters to prepare repair plans and specifications for the bridge and monitor construction. Structural analysis of the Thebes Bridge was carried out, and a correlation was made between the excessive live load response of the spans, the locations of significantly worn truss joints, and the floor system and lateral bracing defects including cracks and rivet failures in stringer/floorbeam connections, truss lateral bracing connections and stringer lateral bracing connections. The first phase of the repair program subsequently developed by Dr. Zolan Prucz of Modjeski and Masters was the truss joint repairs project recently completed by Kiewit Western Company. Construction of the second work phase, including floor system repairs, is currently in progress under a separate contract.



Completed Type L8 truss joint repair.

Additional truss pin joint repairs are also being planned for the future.

The completed truss joint repair project restored ten truss joints. Those ten joints, five on each side of the bridge, were selected for repair due to their extent of wear which varied per member with maximum measurements of ¾ inch and due to their locations which were expected to have the most significant effect on truss stiffness. All of the ten joints are lower chord truss joints and each joint connects members that go through load reversals.

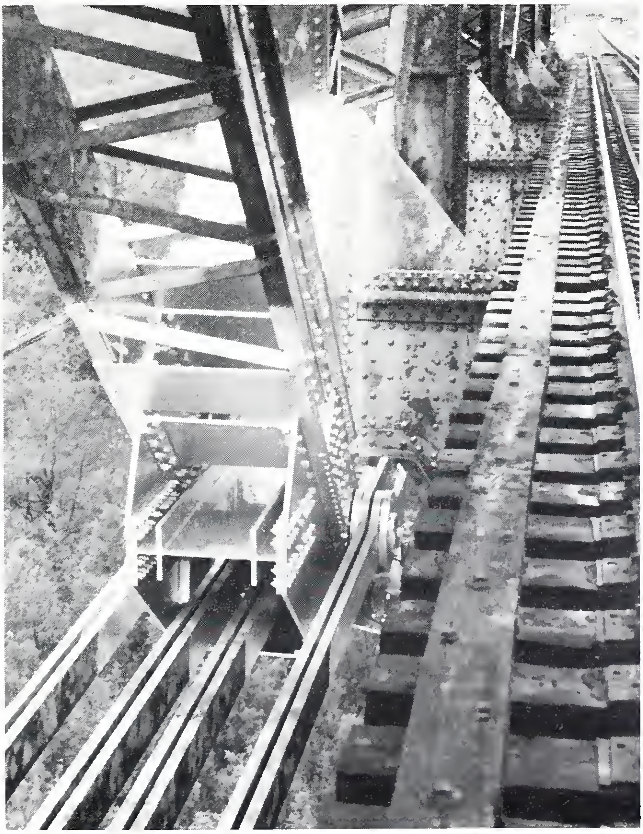
In Spans II and IV, the fixed spans, the repaired joints are at midspan (two per span, one each side), and are referred to as Type L8 repairs. The Type L8 repair interconnects all of the members at the joint (lower chords, diagonals and vertical member) with gussets to bypass the pin entirely. Member loads at these joints, with traffic and impact, range from approximately 2,500 tons tension to 1,300 tons compression.

In Spans I, III and V, the repaired joints are at the center of the suspended portions of those spans (two per span, one each side) and are referred to as Type L6 repairs. The Type L6 repair joins the vertical and diagonal members together with gusset plates and locks the pin into position. The original lower chord eyebar members remain connected by the pin at the Type L6 joints, since there was no significant wear between the eyebar heads and the pin. Member loads at these joints, with traffic and impact, range from about 2,000 tons tension to 300 tons compression.

The repair concept of permanently modifying the worn pin joints to "fixed" joints with gusset plates evolved after the initial consideration of reboring the pin holes through the members and replacing the existing pins with oversized pins. Considering the sizable loads in these truss joints, the problem with replacing the pins while minimizing rail traffic interruptions was how to temporarily support the bridge to maintain the capacity to carry traffic. Falsework below the structure would have been extensive. The concept of installing temporary plates between the members to carry the loads and hold the member positions, in effect bypassing the pin during its replacement, was investigated. This idea was then developed into the final repair of permanently installing the plates and leaving the existing pins in place, which then provide varying degrees of redundancy. The repair design was based upon the present practice of truss joint gusset plate design.

Detailing and Sequencing

The most involved task of the retrofit design was the detailing and sequencing. The detailing and erection sequencing, which were more refined by Kiewit Western Company and their fabricator for construction, were critical in order to maintain the capacity to carry trains throughout the various stages of partial joint disassembly. Although the two repair types were based upon the same concept, the existing details of the joints and, therefore, the required repair details were very different and two separate erection sequences were necessary. Also, although the repair details were grouped into only two different types, Type L6 and Type L8, the existing amount of wear and misalignment present in the joints was different at each location. The original geometrical relationship between the members in a joint could not be relied upon for the repair details, since each joint had its own actual geometry. This was a difficulty since original rivet holes in the members were to be reused for the bolted gusset plate connections. The repairs were developed with some flexibility to reduce the amount of joint realignment work that would be necessary. Details, including the provision of variable shim packs and the shop provision of undersized bolt holes in specific bolt patterns for field reaming, provided some alignment tolerance for the field construction work.



Completed Type L6 truss joint repair.

The repairs were generally set up such that the majority of erection work, except for the final connections to tie the members together, would mostly be done under traffic. Some steps in the erection sequences consisting of removal or installation of specific fasteners and pieces had to be done between trains. Then, the final gusset place connections tying the members together were to be made during one 8-hour full traffic closure per joint. The 8-hour closures were planned to be on Mondays since that day would be least disruptive to the railroad's operations. The joint repairs were required to be essentially completed on one side of the bridge at a time. The track on the side of the bridge being worked on was taken out of service, which served a dual purpose. Having one track out of service not only provided access for the repair work, but was necessary to reduce the member loads in the partially disassembled truss joints. The one track restriction also reduced the full traffic closure time by making it possible to restore service with only 50 percent of the fasteners installed.

Coordination between the contractor's work and the railroad's operations is extremely important on a project of this type. That coordination, along with the contract administration, flagging and inspection work, was handled well by Southern Pacific's bridge and building personnel, supervised by Mr. Butch Lunsford.

The completed repairs have a dampening effect on the behavior of the spans under traffic, and the project is considered a successful step toward extending the life of the bridge.

Now I would like to introduce Bob Grove of Kiewit Western Company, who was the project superintendent. He will present the challenges encountered and methods used for construction. Kiewit Western Company produced high quality work. It was a pleasure working with both Mr. Grove of Kiewit Western and Mr. Lunsford of Southern Pacific on this project.

Mr. Grove: Thank you, Ralph. Kiewit Western Company has been doing quality construction work in all disciplines—heavy, commercial, industrial, tunnels and railroad—since 1884. We are honored to be asked, along with Modjeski and Masters, to make this presentation on the fixing of truss joints on the Thebes Bridge.

We are "safety first" oriented, as is the railroad, and since safety is one of the very first considerations in planning how a job will be built, comments about safety are in order.

We hold weekly safety meetings on all of our projects and perform weekly hazard analysis for all operations. This was true throughout this project. Continuing concerns were:

Falls: At heights up to 100 feet over the water, preventing workers from falling was one of the reasons for substantial scaffolding being installed. Static lines, safety belts, life rings and life jackets were provided and their use required.

Eye protection: At night, under lights with the reaming and drilling, steel shavings could actually be seen floating in the air. Eye protection was provided and the use required.

Trains: Stepping into the live track and keeping the track clear were constant concerns. An air horn was blown when trains approached the bridge, allowing drill bits, reamers and fingers to be removed from the moving, overlapping plates. Kiewit Western Company would like to acknowledge the invaluable support of the flagman, furnished by the railroad, B&B foreman Robert Edwards. He was with our people throughout most of this project and handled the very difficult job of coordinating the railroad's operations with our operation with the greatest amount of professionalism I have seen. B&B foreman Lee Herrington and B&B supervisor Butch Lunsford helped Robert at various times. All of their input into our safety program was solicited and appreciated by myself and Kiewit Western Company.

Kiewit Western Company was awarded the contract to fix certain joints on the Thebes Bridge on July 5, 1989. We received the notice to proceed on August 15, 1989, and the first load of fabricated steel arrived on site by September 8, 1989.

Prior to shop drawing production, Kiewit Western Company and the steel fabricator, Johnson Machine Works, Inc., Des Moines, Iowa, with no live load on the bridge, attempted to precisely measure the existing relative position of rivet patterns on the members about their connecting pin. After a train passed over the bridge and upon remeasurement, we found a difference of 3/16 to 5/16 of an inch from the previous measurements. The bridge did not always come to rest with the same relative member positions.

With approval of the railroad and Modjeski and Masters, we planned to fabricate the new connection materials to the original 1903 truss joint geometry. A cautionary note from Modjeski and Masters was issued to Kiewit Western Company that the necessary rigging and jacking to bring relative positions of members into bolt up tolerances could strain an already tight "eight-hour Monday closure" for the final fix of a joint.

The L-6 joints were rigged prior to the start of the "eight-hour Monday closure" and the final jacking took less than 10 minutes. A 55-ton jack with gauges that allowed the jacking force to be monitored was placed on the pin beneath the floorbeam to raise the vertical member, and chain hoists were applied to opposite gussets already secured to the diagonals. No jacking was necessary for L-8 joints since we field drilled, in place, the holes through the overlapping gussets using templates to match the original rivet patterns of the diagonal members.

The L-6 erection sequence had, in preparation for the "eight-hour Monday closure," eight events that required short duration traffic closures, which amounted to about 20 hours (+/−) tracking time per joint. The L-8 erection sequence had, in preparation for the "eight-hour Monday closure," 10 events that required short closures, which amounted to about 35 hours (+/−) tracking time per joint.

The project required the installation of scaffolding, steel erection and sandblasting and painting at 10 truss joints. The structural steel work included the removal of 8,400 rivets, the installation of 25,000 bolts including those for temporary erection, the placement of 1,548 inches of 5/8 fillet weld in the field, the reaming or drilling of 8,500 bolt holes and the erection of 320,500 pounds of steel with the heaviest piece weighing 3,927 pounds.

Kiewit Western Company put to work up to 20 men, two N55 National Crane trucks with folding booms and no counterweight to foul the live track, one mechanic truck with crane, one ¾ ton pick up truck with fuel storage, five 185 CFM compressors, five 200 amp welding machines, two eight kilowatt generators, three three and one-half kilowatt generators, five magnetic drills, 10 rivet busting tools and six one-inch drive impact wrenches.

The compressors were permanently placed for job duration on bridge refuge platforms, already in place, and hoses were run to air manifolds placed at each joint repair location, on the adjacent bottom chord member, along with welding machines, generators and tool boxes.

Heavy duty scaffolds, with the capacity to handle 8,000 pounds of men, tools, bolts and plates at any one time, were placed at each of the five downstream joints, then moved to upstream when appropriate.

When the first scaffold was complete, a crew began sandblasting. This took one day for an L-6 joint and one and one-half days for an L-8 joint. When one joint was sandblasted, a crew began removing rivets. When the rivets were removed, a crew began the erection sequence for that joint. This collective activity required that work on two or more joints be in progress at the same time to take advantage of tracking time.

The specifications called for holes at final connections to be subdrilled to 11/16 inch, then reamed to 15/16 inch to fix a joint. Kiewit asked for and received the first "eight-hour Monday closure" at the Span V downstream joint on October 23, 1989. It took 13 hours.

Kiewit Western proposed and the railroad and Modjeski and Masters approved a plan where Kiewit Western would, during track time for other operations, jack, align, predrill and preream the 11/16 inch holes. This left only jacking, aligning, bolting and welding of the bearing plates to be performed during the "eight-hour Monday closure" for the L-6 type joint. Subsequent L-6 type joint were fixed in four to six hours. The L-8 type joints, using this system, required only one and one-half to two and one-half hours to make the final connections, eliminating the need for an "eight-hour Monday closure" on those joints.

Winter hit early in November. Temperatures dropped as low as four degrees and winds were getting to 35 mph on the bridge. Kiewit Western proposed, and the railroad accepted, a winter shutdown that ran from December 15, 1989, to April 2, 1990.

The three L-6 joints on the downstream side were complete and the two L-8 joints were approximately 60 percent complete when we shutdown. Preparation for the shutdown required certain diaphragms and plates to be reinstalled and 100 percent of the bolts to be in place on the then unfinished L-8 joints. It took Kiewit Western one week to do this and place equipment in winter storage.

Double-track service was restored on the bridge for the shutdown period. Bi-weekly inspections were performed by Kiewit Western, with reports going to Modjeski and Masters and the railroad. The work already in place showed no adverse effects due to the shutdown.

The downstream side was completed May 5, 1990; the south track then being placed in full service and the north track taken out of service. Scaffold work, rivet busting and sandblasting had been underway on the upstream side for five weeks. The paint contractor, Adams and McCord of Dexter, Missouri, started May 2, 1990, and finished the last joint, Span IV upstream, on August 1, 1990, right behind Kiewit Western. Kiewit Western gave up the north track to return the bridge to normal railroad operations on August 2, 1990, completing the restoration work on the 10 truss joints on the Thebes Bridge.

An area of work which caused Kiewit Western some concern was the removal of rivets. The specifications precluded the torching or burning out of rivets. The rivets connecting two plates were not difficult to remove. The rivets connecting three or more plates were always very difficult to knockout.

We were able to demonstrate to Modjeski and Masters and the railroad that by using a burning bar, a method of burning a precise 3/8 inch hole through the center of the rivet, the rivet would shrink away from the surrounding steel while cooling, allowing an easier knockout. No damage was done to the remaining steel. Water and fire blankets were used to prevent fires.

Another area of concern was the handling of plates. One assembled unit weighed 5,500 pounds. This approached our knuckle boom picking capacity maximum and required outriggers placed fully extended. A saddle was constructed to straddle the knee brace at the floor beam connection to the vertical member and was clamped in place with boiler clamps to support the outrigger.

We also found that annular steel cutting bits on 3/4 inch holes and up are much more efficient than the twist bits.

Once again I wish to thank you for the honor of speaking before this group and if Ralph has no comments and there are no questions, this concludes our presentation. Thank you.

President Burns: Thank you, gentlemen. I want to remind everyone that there are copies of all Bridge and Building special subject reports at the back of the room at no charge. Also, there are yellow cards you can use to sign up for the 1991 special subjects. Take a couple back with you and pass them along so more people can get involved.

At this time we have reached the point where we will adjourn. Be sure to meet with your friends this evening at the reception sponsored by REMSA in the Grand Ballroom from 6 to 7:30 p.m. We will meet back in the Red Lacquer room at 8:30 tomorrow morning.

Adjourn

WEDNESDAY JOINT SESSION

September 19, 1990

President Burns: I'd like to call this final joint session to order. First of all I would like to thank REMSA for the wonderful reception last night. I had a wonderful time and I'm sure everyone else did too. It was great to see everybody. At eight o'clock this morning our registration stood as follows: 169 Roadmasters, 95 B&B, 182 Associates, 159 Guests, 84 Ladies, for a total of 689. I would like to now turn the podium over to Randy Karsten who will introduce our first special feature this morning. Randy.

Mr. Karsten: Thank you, Byron. It is my pleasure to introduce the next presentation which is entitled, ''Box Girder Span Replacement Installation'' by Nick Marianos, bridge design engineer for Modjeski and Masters Consulting Engineers and Ken Wammel, engineer of bridges for Southern Pacific Lines. Mr. Wammel, who was a director of the B&B Association from 1975 to 1978 asked me to extend his apologies and regrets for not being able to be here today. As many of you are probably subscribers to Trains Magazine I'm sure you saw the article about the SP pier settlement problem at the Trinity River in Liberty, Texas. At any rate, Ken was needed back in Liberty for final repairs this week.

Mr. Marianos, who will give both portions of this report, received his Bachelor of Science degree from Tulane University in 1981; his Master's Degree from the University of California in 1985, and is presently working on his dissertation for his Ph.D. back at Tulane. It's interesting to note that Nick's subject of his dissertation has to do with the effects of truck traffic on highway bridges. Nick has been the design engineer and structural analyst for many projects. Nick is a self-confessed bridge nut and, in fact, even gave his wife an engagement ring on the Golden Gate Bridge.

Included in Nick's presentation is a video segment so you may want to move to a seat a little closer to a monitor. Nick, it's all yours.

QUICK CHANGE BOX GIRDER SPAN INSTALLATION

K. L. Wammel

Southern Pacific Transportation Company

and

W. N. Marianos

Modjeski and Masters

In a recent construction project at Schertz, Texas, the Southern Pacific Railroad's San Antonio division made creative use of their own personnel and equipment to replace a turn-of-the century bridge under traffic. The highlight of this project was two single-day replacements of 154'-6'' through trusses with two spans each of prestressed concrete girders.

The original bridge at Schertz was built in 1899. It consisted of a 30-foot plate girder span, two 154'-6" through-trusses, and an 87' pony truss span. The bridge crosses Cibolo Creek, which is dry through most of the year, but can experience flash flooding in the spring and fall.

In 1944 the bridge was rebuilt to upgrade its capacity from E-48 to E-72. During this rehabilitation, the pony truss was replaced by a timber trestle and the through-trusses were rebuilt. The trusses were supported on timber pile bents and stripped to the floor system. They were rebuilt using pin-connected box H-members. Various repairs were made over the years to the structure, resulting in such features as mixing of weldment and riveting and replacement of rivets broken due to fatigue with high-strength bolts.

By the early 1980's, the bridge was showing serious deterioration, and a slow order of 50 mph (down from 70 mph normal speed) was imposed. Modjeski and Masters Consulting Engineers conducted a major inspection of the bridge which revealed several problems. Pounding was noted at the bearings, and the expansion bearings were found in the fully expanded position at normal temperatures. Some bowing was seen in truss vertical members and lateral bracing. Most importantly, significant wear was discovered at the truss pin-joints. Movements of up to 5/8" were measured at pin nuts as trains crossed the bridge. Given these problems, Southern Pacific decided to study the repair or replacement of the structure.

Modjeski and Masters was asked to study the feasibility of several bridge repair and replacement alternatives. Five were developed conceptually and compared. These were:

1) Repair of the existing trusses

2) Replacement of the trusses with 154'-6" through girder spans

3) Construction of two intermediate bents, and replacement of the trusses with four open deck steel girder spans

4) Same as Alternative 3 but using ballasted deck steel girder spans, and

5) Construction of two intermediate bents and replacement of the trusses with four 78'-11" prestressed concrete box girder spans.

Alternatives 2 through 5 included replacement of the timber approach trestle and deck girder span with Southern Pacific's standard bents and prestressed concrete box girder spans. Alternatives 3 through 5 required construction of two intermediate bents at the midspan of the existing trusses. A hydraulic study was conducted to determine the effect of these supports on stream flow during flooding. It was found that the proposed design had minimal adverse effects on flood flow capacity.

Several criteria were used in evaluating alternatives. These included:

1) Initial cost
2) Disruption of rail service during construction
3) Load capacity
4) Expected life
5) Maintenance needs
6) Clearance provided for trains, and
7) Feasibility of construction by Southern Pacific forces.

Based on these guidelines, the railroad selected alternative 5, replacing the existing two existing trusses with four 78'-11" prestressed concrete box girder spans and replacing the timber trestle and deck girder with SP standard box girders. Modjeski and Masters was authorized to proceed with a final design using this concept.

The structure replacement plans were prepared in accordance with the American Railway Engineering Association specifications. Four box girders were used for each 78'-11" span. Each box girder was prestressed with 64-1/2" diameter 279 ksi. strands. Concrete strength was specified as 6000 psi. The exterior box sections carried sidewalls forming a ballast trough. A concrete walkway was cantilevered from each sidewall.

These boxes and the Southern Pacific standard sections were supported on the existing abutments and piers and new intermediate bents. The intermediate bents consisted of H-pile sections driven to specified depth and extending to 1'-6" below the top of pier elevation. A concrete jacket extending the full height of the bents was cast around the piles to protect them from debris damage during flooding. Steel reinforcing bars were used to prevent temperature and shrinkage cracking in the jacket concrete.

The design included required modifications to the existing abutments and piers. Standard Southern Pacific bridge details were used as much as possible throughout the design.

While Southern Pacific forces frequently replaced timber trestles and small bridges with prestressed box girders, this project was one of the largest they had faced. The task of replacing the two trusses with box girders during 12-hour track closures was especially challenging, and required careful planning and preparation.

After the design drawings were delivered, the railroad began its preparations. Construction was directed by Norris Carnes of the San Antonio division of Southern Pacific. Engineering support was provided by Bob Bowlin (now of the Houston division) and Don Clayton, now retired from the Houston Engineering office. Most of the work was done by railroad forces using their own equipment. The concrete box girders were ordered from Texas Concrete in Victoria, Texas. Most of the other supplies came from railroad stock.

One of the first phases of construction was pile-driving. A locomotive pile-driving rig with a McKiernen-Tierney diesel hammer was used to drive HP 14 x 73 piles through the timber trestle and the floor system of the existing trusses. Bracing members were welded to the H-piles after driving. Reinforcing bar cages for the intermediate piers were built and put in place. The railroad then erected forms for casting the concrete jackets around the intermediate pier piles and poured the new piers. During construction, train speed was limited to 30 mph.

Construction continued with the replacement of the timber trestle and the deck girder span. This work required some adjustment of the track grades approaching the bridge. Precast concrete bolster blocks were used at abutments and existing piers to meet the required girder elevations. As the precast standard girder sections became available, they were installed at the bridge site.

With the completion of the intermediate piers and replacement of the approach spans, preparations began for replacement of the two truss spans. Railroad forces brought in fill materials and compacted it below the spans to provide a level and stable work surface. Some 2,000 cubic yards of fill were required. Drain pipes carried stream flow (low at this time of year) beneath the filled area.

Arrangements were made to truck the girders to the bridge site in sequential order as required for installation and to rent 150-ton capacity truck cranes. Each truss was replaced on a separate day to minimize disruption of rail service. The date of the first truss replacement was set for June 16, 1988.

The track was closed to train traffic at 5:30 a.m. on the scheduled date. The truss to be removed was jacked up and supported on two "rollout bents." These temporary supports were frames made of H-pile sections welded together and mounted on rail trucks. Similar bents had been used successfully on earlier Southern Pacific bridge replacements. The trucks were taken from freight cars, with the springs removed and replaced with timber. The trucks ran on track panels laid on the fill running transverse to the center line of the truss. The fill was well compacted beforehand to prevent settlement of the rails. The roll-out bents were located at the first panel point from each end of the truss. Cable guys provided additional stability to these temporary supports. After being jacked up to clear obstructions on the pier top, the truss was secured to these temporary supports and rolled to the side, out of the construction work area. Each truss was estimated to weigh about 325,000 lbs. Removal of the truss was completed by 7:00 a.m. Later in the day, cranes lowered the truss to the ground, where it was cut up for scrap.

After the existing truss was removed, final modifications were made to the existing pier tops. Elastomeric bearing pads for the girders were placed and anchor devices installed. Then the four girders for each span were lifted into position. The heaviest box girders weighed 69 tons. After the girders were placed, epoxy grout was poured between each box, and steel rods were installed to tie the four girders together in a single unit. The same procedure was followed for the second span.

When both 78′-11″ spans were in place, preconstructed track panels were laid on timbers on the bridge deck. Ballast was dumped over the panels, and the track was raised to grade as the ballast was tamped down and the timbers removed. After the rail connections were made and the track grade on the remaining truss adjusted, the new spans were ready for service. The first train crossed the replacement spans at 5:45 p.m. The process of replacing one of the existing trusses with two new prestressed girder spans had taken only 12 hours and 15 minutes.

The following time schedule details the replacement process:

Begin	End	Duration	Activity
	0530		Train traffic suspended.
0530	0615	45 min.	Rail joints unbolted and cut.
0615	0645	30 min.	Span jacked at each end, timbers placed atop roll-out bents, jack removed.
0645	0655	10 min.	Span rolled out of position to area for dismantling.
0655	0830	1 hr., 35 min.	Roll-out bent track panels removed, area graded, 2 cranes positioned for setting girders.
0830	0930	1 hr.	4 - 77 ft. long girders set in place.
0930	1030	1 hr.	Cranes repositioned.
1030	1115	45 min.	4 - 77 st. long girders set in place.
0930	1500	5 hr., 30 min.	Epoxy girder joints.
1300	1600	3 hrs.	Set track panels as area became available.
1600	1730	1 hr., 30 min.	Bottom dump ballast, tamp, bottom dump to grade.
1330	1530	2 hrs.	Position 4 cranes and lower rolled out span to ground, tip span over to facilitate scrapping.
1745			Restored train traffic.

The second truss was replaced similarly several weeks later. After the replacement process was completed, cleanup operations continued at the site to remove the fill material and the old trusses. Handrails were installed on the completed structure, and some minor repairs were made to the old piers and abutments. The total amount of time required for the project was about eight months. Cost was approximately one million dollars. The box girders cost about $8,000 each.

The Southern Pacific Railroad now has a modern prestressed concrete bridge, capable of carrying E-80 loadings with unlimited vertical and horizontal clearance. The new Schertz bridge over Cibolo Creek has a expected life of 100 years, with low projected maintenance costs. Construction was done by Southern Pacific's own forces, who displayed craftsmanship and ingenuity while replacing the bridge under traffic.

To record the ''quick-change'' span replacement, Southern Pacific forces made a videotape of the truss removal and box girder installation. (Whereupon there was a videotape presentation) (Applause)

President Burns: Thank you, Nick. I'll now turn the program over to Ron Poulsen who will introduce the next feature. Ron.

Mr. Poulsen: Thank you, Byron. The next presentation this morning is ''Safety in the Railroad Industry Today''. It probably should have been our Monday morning presentation since safety is our number one priority in the railroad industry these days. This presentation this morning will be made by Richard Reynolds. Richard is currently the manager of safety for engineering services with the Union Pacific Railroad in Omaha, Nebraska. He has 21 years experience in the railroad industry and has been a trackman, machine operator, mechanic, roadmasters and superintendent of roadway equipment. Richard has also worked for a railroad equipment manufacturer and a railroad equipment leasing company. He is a member of the Roadmasters and Maintenance of Way Association of America, the American Railway Bridge and Building Association, the American Society of Safety Engineers and the American Railway Engineering Association, including participation on AREA Committee 27.

SAFETY IN THE RAILROAD INDUSTRY TODAY

Richard K. Reynolds

Manager of Safety for Engineering Services
Union Pacific Railroad

Good morning. It's good to be here and I appreciate the introduction. You know, I was talking to someone earlier and they asked me if I was going to speak this morning and I told them I was, and they asked what my background was and I told them. Then they asked me where I was from. And when I told them I was from Texas, he goes, "Oh. Well, then we only have to believe half of what you say this morning." (Laughter)

The topic I have this morning is "Safety in the Railroad Industry Today." The railroad industry is entering a new decade. Competition is stronger than ever and to survive and prosper we must simply be the best in everything that we do. Safety is no exception. To become the world class industry we want to become will require the leadership and commitment in this room plus all of the employees in the field not here today. An industry is recognized as world class only when it demonstrates the ability to effectively and consistently manage its human and financial resources. There are no world class industries that are poor safety performers.

Why is safety important? Simply because of injury to employees, loss of skilled workers, loss of production, and cost to company. I am sure the first thought that comes to mind is that none of us want to be hurt, see a fellow employee hurt, or have our families suffer from an injury. We want to come to work, complete our task and return home in the same shape as when we left. To ensure this happens, each of us has different responsibilities. Management must provide the atmosphere, material, equipment and training to the employees who do the actual work to safely accomplish their task. Local managers and supervisors must develop the plans to safely accomplish the work based on various guidelines. Employees who do the actual work should be included in the development of the plans. And, finally, the individual who does the work is responsible to do it safely according to the plan and applicable rules.

After we, as management and supervisors, have done our part we must remember that committees, rules, instructions, and videos will not prevent injuries alone. This has been proven by the number of injuries we continue to have in the industry with all of the above in place. We cannot legislate safety as we cannot legislate morality. Safety comes from the individual's own motivation to work safely and look out for his fellow worker. When we, as managers, are able to tap into what truly motivates an individual then we will be on the way to having a safer workplace.

I have recently seen an example of a supervisor who has been able to reach his employees and cause them to motivate themselves to have a perfect year in safety. Our panel plant at North Little Rock, Arkansas, had a terrible safety record and morale problem in 1989 with 16 injuries for the year. With the supervisor's commitment, listening, intervention, and actions, he was able to earn the respect of his employees and had the credibility which provided the atmosphere and improved morale for employees to motivate themselves to work safely. Not only has safety been moved to a number one priority status for 1990 but production and quality have also improved.

When management sets policies and procedures and buys tools and equipment we must always keep in mind the people following the policies and procedures are using the tools and equipment. We should ask, "Is this really safer?" Or, "Is it feasible when put into the workplace?" Or "Is it hindering the task at hand?" We as managers or supervisors must become personally involved with our people, setting examples showing true commitment to safety and enforcing rules and policies in order to have the credibility needed to have the trust and respect of our people and also provide positive confirmation for a job well done. All employees at all levels want and need this approval from their superiors as well as fair and just discipline. We must point out safety violations regardless of how trivial they may be or we are condoning that unsafe act.

There are legal requirements which also focus our attention on safety. We must meet OSHA (Occupational Safety and Health Administration), FRA (Federal Railroad Administration), DOT (Department of Transportation), and EPA (Environmental Protection Agency) regulations. In our increasingly legalistic society regulations are becoming more complex and additional emphasis is being placed on enforcement by the various agencies. Not only can a company and management be fined for non-compliance, but a supervisor or employee can be penalized for unsafe behavior.

In the August 20th issue of Business Week an article entitled, ''A New Chief Has OSHA Growling Again,'' the new chief, Gerard Scannol, puts teeth into his ''Safety Pays'' campaign. To quote from Labor Secretary, Elizabeth Dole, ''In a show of force he hopes will deter others, Scannol has imposed substantial fines, including $7.3 million against USX Corporation for safety, health, and recordkeeping violations. He favors litigation that would stiffen criminal penalties to as much as ten years in prison for violations that lead to a worker's death. ''It will show employers the seriousness with which we view exposing employees to physical harm,'' Scannol says. The article goes on to say, ''Scannol has no intention of backing down on his big fine policy. Whacking a chief executive or two he thinks may persuade others to put safety higher on their agendas.'' In this legalistic mode we work under we must all work closely with our tool and equipment suppliers to make safer and more economic tools and equipment. Manufacturers must also seek help from their customers in the design in the safety of tools and equipment as joint liability is now, and will be in the future, a big part of litigation.

Ergonomics, the sciences of the interaction of people, their machines and their environment can reduce worker injuries. It is especially an important tool against cumulative trauma syndromes, such as carpal tunnel related to vibration or repetitive motion. Ergonomics can help worker productivity as well. Ergonomics in the design of tools and equipment in the railroad industry is becoming very evident by the response and support of our suppliers. We have been working with suppliers by making quality audits of their facilities and going to the plants when the new machine is completed to go over the items that need to be changed ergonomically before they deliver it to us. This has resulted in equipment that hits the ground running with modifications and safety features in place, without a service representative showing up with arms loaded with modification parts. This policy has been invaluable to the people in the field using the equipment, by management showing commitment to having the best equipment possible. We cannot let this relationship with suppliers lose its momentum.

The future is in mechanizing every task that we can. But we must remember that even though machines will relieve repetitiveness and heavy lifting the equipment will still require human skill to operate, maintain, and repair it. We will have to have a smarter and more skilled workforce. In this area, I think we, as an industry, fall behind. Vocational and in-house training is a must to keep our people up with the technology in our equipment. Safety awareness training needs to also be increased as railroad technology increases.

The third aspect is the financial drain on the industry. The cost for FELA claims in 1989 to the industry as a whole was $800 million. Had we been able to avoid these injuries we would have been able to surface and line more track, lay more rail, install more ties, build more bridges, and maintain more employees on the payroll, all things we would rather have spent our money on. These failures take away from our ability to put this money into the critical areas which we need to operate and manage a world class railroad.

Safety is important no matter how you look at it. We must not lose sight of its most important aspect and that is the safety of our employees, the human aspect. We can replace equipment. We can be prosecuted and sent to jail no matter what our job is, but one thing we can't do is reverse the consequences of a serious injury or fatality. The effects of unsafe performance are all too often permanent. Management must take a hands-on approach to the safety process and we must forge a stronger partnership between labor and management to make the railroad industry a safer place to work.

As examples of some of the real issues we need to tackle, let me mention several opportunities. Quality teams between labor and management have to become effective with union representatives supporting the activities of the teams in order to improve the quality of work produced, procedures for a task and quality of tools and equipment.

Back injury prevention is vital as it is the number one area for claim payouts. Education concerning lifting techniques and the use of lifting devices and packaging of materials should be part of this issue. But as we all know, in some cases of back injuries a new cure has been discovered called the green poultice.

Managers should make audits on gangs, equipment, shops and vehicles. These need to be genuine audits with time taken to get the whole picture concerning safety. Audits are of little value without thorough follow up. Don't do them in a negative way but as train and accident prevention.

Personal conferences with the injured employee are also a must. You will be amazed at what comes out of these personal conferences. You get an opportunity to see the incident as the injured employee saw it. It is not always the same perception that we have but after talking to the employee we find out more about the circumstances that led up to the incident.

In the majority of the incidents the employee will have been trying to do a good job but simply did not think, was taking a short cut, or was trying to work too fast or didn't take time to have a short job briefing before attempting the task.

Investigation of injuries should be done well in order to prevent reoccurrence. In our investigations we should keep asking questions about the incident until we come to an event that is preventable. By removing this event we disrupt the sequence that led to the incident and prevent a future recurrence. An example of this is, Joe is walking down the sidewalk and throws a banana peel down on the sidewalk. A little old lady comes along and slips on the banana peel, falls down and hurts herself. We could write policies and rules that state, "Look out for a banana peel on the sidewalk" or put up signs that say, "Caution! Banana peel may be on sidewalk." We could prevent old ladies from walking on the sidewalk. We could get a manufacturer to invent a banana peel detector and put one on everyone's belt. We could stop grocery stores from selling bananas, or if President Bush had intervened sooner with Noriega he could have stopped him from allowing his country to grow bananas in the first place. The real message in this is that by stopping Joe from throwing that banana peel on the sidewalk we remove the key event that caused the accident.

Looking at past accidents while key is purely reactive. We must also be proactive, working collectively to prevent the incident or injury from happening in the first place. Proactive safety includes taking individual action to eliminate a hazard, talking to a fellow employee who is working unsafely, or using audits and accident investigation to help identify areas of concern and potential solutions. It is not easy to be proactive but the rewards are greater. It is a lot better to prevent an injury from occurring than studying it to prevent it from happening again.

We must deepen our commitment to become the safest railroad in the world. To accomplish this I suggest that we listen, we think, and we contribute to the safety process every day. We all can see safety in the railroad industry today has changed dramatically through management awareness, employee concerns, cost and regulatory agencies. The future of safety in the railroad industry will require trained technical professionals with experience in the industry. To sum it all up we can talk to your ears but not to your heart. You must relay what you hear to your heart because that is where true motivation comes from. Without the motivation we will never improve. We should always do our best, do the right thing and treat others as you want to be treated.

I thank you for letting me speak to you this morning and hope that you all get home safely. (Applause)

Mr. Poulsen: Thank you, Richard. That was an excellent presentation on safety. The next event we have this morning is a video provided by the Norfolk Southern. To introduce that I would like Mike Reid to come up please.

NORFOLK SOUTHERN'S DUAL RAIL LAYING GANG

M.E. Reid

Process Engineer
Norfolk Southern Corporation

Good morning. It is my pleasure to be able to present to you today the manner is which rail is chronologically paneled on the Norfolk Southern. The system rail program is our largest capital expenditure and therefore, it has been of the utmost importance that rail be laid expediently insuring that our high standards for quality are maintained. On our property the implementation of the welding facility in Atlanta, Georgia, and our unique process of dual rail laying originated in 1959. In 1978, to further reduce costs while at the same time strengthening our physical plant, the reweld facility, also located in Atlanta was put into operation. The reweld plant allows for the reclamation and reclassification of release welded rail therefore enabling Norfolk Southern to more effectively reuse the released continuous welded rail.

In the presentation you are about to view, you will see how new rail is welded into strands of rail 1440 feet in length, subsequently loaded onto our rail trains and dispatched to designated work locations where the rail is unloaded on the ballast shoulders and laid by either of the two system rail gangs on Norfolk Southern's property. Directly behind the rail laying operation the released rail is loaded into the empty rail train. Upon completion of loading the train, the released rail is returned to the Atlanta reweld complex where the rail is graded, welded and cascaded along with the track hardware to another designated work location. I think you will see that Norfolk Southern has a unique manner of handling rail. I hope you enjoy this presentation. (Whereupon there was a video presentation)

Mr. Poulsen: Thank you, Mike and the Norfolk Southern for that excellent video. We're going to take a short break and reconvene here at 10:15.

Recess

President Burns: At this time I would like to turn the program over to Mark Walbrun who will introduce our next special feature speaker. Mark.

Mr. Walbrun: The presentation that we originally had scheduled for this time was the Emergency Replacement Span. The actual program was destroyed in a car accident and there was a lot of hard work put in by Doug DeBerg but unfortunately it was all destroyed. We would like to thank him, however, for his efforts. Instead, Jim Budzileni, who is retired senior structural engineer from the Illinois Central Railroad, will present the History of American Railway Bridges. It's a fine presentation and I hope you will all enjoy it. Jim.

HISTORY OF AMERICAN RAILWAY BRIDGES

Jim Budzileni

Illinois Central Railroad

Before I start I would like to remind Byron that the nice thing about being a past president is that you are past unless you are called upon to do something. (Laughter) (Whereupon there was a slide presentation)

President Burns: Keith and I were just talking and I said that was a lot more interesting than just looking at some rails and ties and rocks; they all look the same. (Laughter) I really thank Jim for showing that to us. I hope you all enjoyed it. At this time, I would like for Doug DeBerg to come up to the podium to present the Resolutions Committee report. Doug.

RESOLUTION COMMITTEE REPORT

Having reached the closing of the annual joint conference of the American Railway Bridge and Building Association and the Roadmasters and Maintenance of Way Association of America and being deeply indebted to all those members and friends who have contributed their time and efforts to make our conference a success, it is right that we should acknowledge this indebtedness, and that it shall be so entered into the minutes of this meeting.

Be it further resolved, that our deep appreciation be extended to those who have honored our associations with their presence and by their informative addresses:

Michael Haverty, President and Chief Operating Officer, AT&SF RY
Roger Engle, Assistant Chief Engineer, AT&SF RY
Dan Worth, BV&H
Donald Turney, President, American Railway Engineering Association
Jon Schumaker, President, Railway Engineering Maintenance Suppliers Association
Gary Lewis, HDR
Gary Brockington, Wisconsin Department of Transportation
George Willis, Factory Mutual Railroad Insurance Division
Lance Bordon, Modjeski & Masters
Paul Resnik, Shearson Lehman Brothers
Ron Purvis, Wilbur Smith Associates
Ken Norton, Osmose
Bob Grove, Kiewit Western
Ralph Eppehimer, Modjeski & Masters
Richard Reiff, Association of American Railroads
Laurence Weldon, Rail Construction Corporation
Ken Wammel, Southern Pacific Transportation Company
Nick Marianos, Modjeski & Masters
Richard Reynolds, Union Pacific Railroad
Jim Budzileni, Past President, American Railway Bridge & Building Association

and to all the committee chairmen and sponsors, who with the loyal cooperation of the committee members prepared the interesting and instructive reports that have been presented.

Be it further resolved that a very special thanks is expressed to Jon Schumaker, President of REMSA, and to all members of the Railway Engineering Maintenance Suppliers Association for the fine reception that we enjoyed last night. Our thanks are also expressed to Mrs. Carolyn Pottorff and her committee members for their efforts in arranging registration and entertainment for our wives. Our thanks also to the management and staff of the Palmer House. A special thanks goes to Pat Weissmann and Barbara Marlow. Without their unselfish assistance, these two Associations would have great difficulty functioning.

And be it finally resolved that both Associations express their heartfelt thanks to our retiring presidents, Byron Burns and Keith Pottorff, who have spent so much time and effort in guiding the activities of our two Associations with great efficiency and dedication during the past year.

I move these resolutions be adopted.

Respectfully submitted,

Doug DeBerg, Chairman
Resolutions Committee

JOINT INSTALLATION OF OFFICERS

President Burns: Thank you, Doug. At this time I would like to take the opportunity to present plaques to the three out-going directors in recognition of the job they have done. I would like to call Bill Nelson, Tom Parker and Randy Karsten to the podium. The plaque reads, "American Railway Bridge and Building Association presented for services as Director 1987-1990." Each plaque has the director's name on it. (Applause) Now I will turn the podium over to Keith Pottorff.

President Pottorff: Thank you, Byron. I would like to call our two out-going directors, Gene Schubel and Bob Wright, to the podium to receive their plaques that read, "Appreciation Award presented by the Roadmasters and Maintenance of Way Association of America for services as director, 1986-1990." (Applause)

President Burns: I would like the immediate past president of the B&B Association, Mr. Ray Tallent, to install the officers-elect of the American Railway Bridge & Building Association for 1990-1991, and Mr. Al Matte, immediate past president of the Roadmasters and Maintenance of Way Association, to install next year's Roadmasters officers. Ray and Al.

Mr. Tallent: The following is the list of officers-elect of the American Railway Bridge and Building Association for the administrative year, 1990-1991. The officers so named please step forward and take a position on my left: For president, John Horney, bridge engineer, Union Pacific Railroad, Omaha, Nebraska; for senior vice president, Mark Walbrun, project manager-Chicago Union Station, Amtrak, Chicago, Illinois; for junior vice presidents, Paul Saletnik, engineer of buildings, Chicago and North Western Transportation Company, Chicago, Illinois, and William Nelson, manager maintenance of way training, Burlington Northern Railroad, Overland Park, Kansas; for directors with terms expiring in 1993: Donald McCammon, manager bridge and building, Burlington Northern Railroad, Englewood, Colorado; John Creighton, bridge and building master, Canadian Pacific Rail, Toronto, Ontario, Canada; and Johnny Bradley, assistant division engineer-bridges, Norfolk Southern Corporation, Knoxville, Tennessee. Al.

Mr. Matte: The following is the list of officers-elect of the Roadmasters and Maintenance of Way Association for the administrative year, 1990-1991. The officers so named please step forward and take a position on my right. For president, Jerome Cossel, chief engineer-design and construction, Conrail, Philadelphia, Pennsylvania; for first vice president, Stephen Hill, division engineer, Soo Line Railroad, Wood Dale, Illinois; for second vice president, Kenneth Welch, chief engineer-facilities, Union Pacific Railroad, Omaha, Nebraska; for treasurer, Eugene Schubel, division engineer, Burlington Northern Railroad, Springfield, Missouri. For directors with terms expiring in 1994: Wayne Russell, regional engineer, Atchison Topeka and Santa Fe Railway, Albuquerque, New Mexico; Raymond Brosseau, assistant supervisor maintenance of way, Canadian Pacific Rail, Toronto, Ontario, Canada; and David Smoot, executive vice president, Indiana Hi-Rail Corporation, Connersville, Indiana.

Election to a position of leadership in any organization is an honor not to be taken lightly. Your fellow members in electing each of you to your respective office, have expressed confidence in you, first, that you are to discharge your several duties with distinction, and second that you are willing to do so.

Mr. Tallent: As the officers of our associations, you will represent to the citizens the true meaning of railway bridge and building and roadway maintenance and construction. You will be our collective voice in the industry. Thus, you will be our common bond with railway personnel throughout the world.

Mr. Matte: As the officers of our associations, you will represent our best interests in any of your activities or projects, always reminding yourselves that your attitude must be a part in any undertaking sanctioned by your respective associations. In this you will be adhering strictly to the constitution and by-laws of our associations.

As a representative of the Roadmasters and Maintenance of Way Association of America, I install each of you in the office to which you were elected in your association.

Mr. Tallent: As a representative of the American Railway Bridge and Building Association, I install each of you in the office to which you were elected in your association.

Please remain standing so that Mr. Matte and I may come down and congratulate you. The audience may now applaud.

President Burns: At this time I would like to call on Mr. Jon Schumaker, president of REMSA. Mr. Schumaker.

Mr. Schumaker: Good morning. President Horney, President Cossel, past presidents, members of Bridge and Building and of Roadmasters, Ladies and Guests. It is a distinct pleasure for me, as president of REMSA, to congratulate your associations on their selection of new officers and members of your boards. Most of your know that it has been customary at this time, each year, for REMSA to present the incoming presidents with gavels, symbolic of authority during the upcoming terms of office. Therefore, I would like to present this gavel to President Horney of the American Railway Bridge and Building Association.

President-Elect Horney: Thank you. (Applause)

Mr. Schumaker: Now, on behalf of REMSA, I would like to present this gavel to the new president of the Roadmasters and Maintenance of Way Association of America, Jerry Cossel. Jerry.

President-Elect Cossel: Thank you. (Applause)

Mr. Schumaker: And now before presenting REMSA service plaques to outgoing presidents, Byron Burns and Keith Pottorff, I want to thank them and the members of their boards for the excellent cooperation REMSA has received during the past years. So on behalf of our membership I would like, at this time, to present this plaque commemorating his service as Bridge and Building president, 1989-1990 to Byron T. Burns. (Applause)

And to Keith Pottorff a matching plaque commemorating his service as president of Roadmasters, 1989-1990. (Applause)

Thank you.

President Burns: I would like to, once again, thank the board for their hard work and support during the past year. Without their efforts, there would not have been a conference. It was a pleasure working with them. They are a super bunch of people. I would also like to thank REMSA for their hospitality. The staff of REMSA should also be thanked for their contribution to the success of this conference. There are two individuals in the audience who deserve special thanks, Pat Weissmann and Barbara Marlow, who staff the joint association office. You may not know it, but they are the people who actually keep the associations operating. I would like both of them to stand and be recognized. (Applause) I would like to express my personal gratitude for the help they have given me over the years. I wish John Horney, the new president, success in the upcoming year. Judging by the new executive committee, I am certain that he will enjoy the same support that I did. I look forward to working with all of them. John.

President-Elect Horney: Thank you, Byron. In 1979, two things happened in my railroad career that really impacted my perspective on the railroad. First, I obtained a position that more or less placed me in the field more than it did in the office and secondly, Don Gould, one of our past presidents, introduced me to the Bridge and Building Association.

Since that time, on the field side I have continued to learn from the problems and decisions that must be made daily out in the field. I have also learned the necessity of our association. Through these conferences and their Proceedings, which are sent to all of our members, programs are presented that reflect the latest methods of solving those problems we all face out in the field. As members of the Association, both with the Roadmasters and Bridge and Building associations, I urge each of you to contribute your experience and knowledge to the associations, through the committees by either offering information or serving as committee members.

Next year marks the 100th anniversary of the American Railway Bridge and Building Association. I am honored, not only to be elected president, but to hold the office and represent the Association during its 100th year conference next year in St. Louis. There will be additional activities and presentations planned for the conference and we hope to be able to reflect on some of the same subjects that were discussed and presented at the 1891 conference so that we can see just how far we've progressed and perhaps even take a look where we might be 100 years from now. We are looking forward to a very exciting and fun type of conference.

I have had the privilege of working with an outstanding group of people, board members and associates, during the last seven years on the Board. And I would like to thank each of them for the experience they have taught me. I especially want to thank Pat Weissmann and Barbara Marlow for their help and direction; I look forward to working with them this coming year.

To Byron Burns, I would like to note for the record the outstanding work you have done for the Association as president. You performed with an aura of professionalism that was necessary to resolve some very difficult problems including no less than the revision of our Constitution and By-laws. I would now like to present to you, Byron, the plaque in recognition of your fine work. The plaque reads, "American Railway Bridge and Building Association, presented to Byron T. Burns for his service as Vice President 1986-1989 and President 1989-1990." Dated September 19, 1990. Byron. (Applause)

President Burns: Thank you.

President-Elect Horney: I would like to turn the podium over to President Pottorff. Keith.

President Pottorff: I also want to thank the Roadmasters Board. It was a fantastic group; it's amazing how well everyone worked together. Also, of course, Pat and Barbara, without whom many of us couldn't survive these jobs. And REMSA, who helps make this entire conference a success. At this time, I would like Jerry Cossel to come forward for his president's pin with the year 1990-1991 engraved on it.

President-Elect Cossel: Thank you, Keith. I promise this is going to be very short. Initially, I would like to thank Pat and Barbara. Sometimes I can be a pain, but they generally survive and set me straight. Also, Jon Schumaker and REMSA; thank you very much for a wonderful time. I would like to thank the organization for this honor and the nominating committee for selecting me. We, along with the Board, hope to fulfill your expectations in the coming year.

We ask for your participation and especially your participation to help make these programs better. We need input from everyone possible to present interesting and informative programs. As always, our job here is to transfer ideas and help each other do our jobs better. Again, I thank you very much for this honor and hope to see everyone in St. Louis next year.

At this time, I would like to present a plaque to Keith for his service as president of our organization. This is a presentation to Keith Pottorff for services as president 1989-1990 of the Roadmasters and Maintenance of Way Association of America. (Applause)

President Pottorff: Thank you.

President-Elect Cossel: Keith and I both came on the Board in 1982. Eight years of association have been very, very productive and I know I have found a life-time friend. Thank you very much, Keith, for all your work.

Members and guests, if there are no other matters to be brought before this session, I declare this 102nd annual conference of the Roadmasters and Maintenance of Way Association and the 95th annual conference of the American Railway Bridge and Building Association adjourned. (Applause)

Adjourn

Left to Right **— J.G. Bradley, J.T. Creighton, D.L. McCammon, W.H. Nelson, P.H. Saletnik, M.C. Walbrun, J.J. Horney**

1st Row **— M.C. Walbrun, P.A. Weissmann, B.T. Burns, J.J. Horney, J.M. Williams**
2nd Row **— J.A. Lileikis, W.H. Nelson, T.J. Parker, R.A. Tallent, M.L. Bradley, P.H. Saletnik**
3rd Row **— T.V. Dunn, R.C. Karsten, D.F. Sorgenfrei, R.C. Carter, D.G. DeBerg**

Past Officers

	1891-1892	1892-1893	1893-1894	1894-1895
President	O. J. Travis	H. M. Hall	J. E. Wallace	Geo. W. Andrews
1st V.-Pres.	H. M. Hall	J. E. Wallace	Geo. W. Andrews	W. A. McGonagle
2nd V.-Pres.	J. B. Mitchell	G. W. Hinman	W. A. McGonagle	L. K. Spafford
3rd V.-Pres.	James Stannard	N. W. Thompson	L. K. Spafford	James Stannard
4th V.-Pres.	G. W. Hinman	C. T. Fuller	E. D. Hines	Walter G. Berg
Secretary	C. W. Gooch	S. F. Patterson	S. F. Patterson	S. F. Patterson
Treasurer	George M. Reid	George M. Reid	George M. Reid	George M. Reid
Executive Members	W. R. Damon	G. W. Andrews	Q. McNab	James Stannard
	G. W. Markley	J. M. Staten	A. S. Markley	James H. Travis
	W. A. McGonagle	J. M. Caldwell	Floyd Ingram	J. H. Cummin
	C. W. McGehee	Q. McNab	James Stannard	R. M. Peck
	G. W. Turner	Floyd Ingram	James H. Travis	J. L. White
	J. E. Wallace	A. S. Markley	J. H. Cummin	A. Shane

	1895-1896	1896-1897	1897-1898	1898-1899
President	W. A. McGonagle	James Stannard	Walter G. Berg	J. M. Cummin
1st V.-Pres.	L. K. Spafford	Walter G. Berg	J. H. Cummin	A. S. Markley
2nd V.-Pres.	James Stannard	J. H. Cummin	A. S. Markley	C. C. Mallard
3rd V.-Pres.	Walter G. Berg	A. S. Markley	G. W. Hinman	W. A. Rogers
4th V.-Pres.	J. H. Cummin	R. M. Peck	C. C. Mallard	J. M. Staten
Secretary	S. F. Patterson	S. F. Patterson	S. F. Patterson	S. F. Patterson
Treasurer	George M. Reid	N. W. Thompson	N. W. Thompson	N. W. Thompson
Executive Members	R. M. Peck	W. O. Eggleston	G. J. Bishop	Wm. S. Danes
	L. J. White	W. M. Noon	C. P. Austin	J. H. Markley
	A. Shane	J. M. Staten	M. Riney	W. O. Eggleston
	A. S. Markley	G. J. Bishop	Wm. S. Danes	R. L. Heflin
	W. M. Noon	C. P. Austin	J. H. Markley	F. W. Tanner
	J. M. Staten	M. Riney	W. O. Eggleston	A. Zimmerman

	1899-1900	1900-1901	1901-1902	1902-1903
President	Aaron S. Markley	W. A. Rogers	W. S. Danes	B. F. Pickering
1st V.-Pres.	W. A. Rogers	W. S. Danes	B. F. Pickering	C. C. Mallard
2nd V.-Pres.	J. M. Staten	B. G. Pickering	A. Shane	A. Shane
3rd V.-Pres.	Wm. S. Danes	A. Shane	A. Zimmerman	A. Zimmerman
4th V.-Pres.	B. F. Pickering	A. Zimmerman	C. C. Mallard	A. Montzheimer
Secretary	S. F. Patterson	S. F. Patterson	S. F. Patterson	S. F. Patterson
Treasurer	N. W. Thompson	N. W. Thompson	N. W. Thompson	N. W. Thompson
Executive Members	T. M. Strain	T. M. Strain	A. Montzheimer	W. E. Smith
	R. L. Heflin	H. D. Cleaveland	W. E. Smith	A. W. Merrick
	F. W. Tanner	F. W. Tanner	A. W. Merrick	C. P. Austin
	A. Zimmerman	A. Montzheimer	C. P. Austin	C. A. Lichty
	H. D. Cleaveland	W. E. Smith	C. A. Lichty	W. O. Eggleston
	A. Montzheimer	A. W. Merrick	W. O. Eggleston	J. H. Markley

	1903-1904	1904-1905	1905-1906	1906-1907
President	A. Montzheimer	C. A. Lichty	J. B. Sheldon	J. H. Markley
1st V.-Pres.	A. Shane	J. B. Sheldon	J. H. Markley	R. H. Reid
2nd V.-Pres.	C. A. Lichty	J. H. Markley	R. H. Reid	J. P. Canty
3rd V.-Pres.	J. B. Sheldon	R. H. Reid	R. C. Sattley	H. Rettinghouse
4th V.-Pres.	J. H. Markley	R. C. Sattley	J. P. Canty	F. E. Schall
Secretary	S. F. Patterson	S. F. Patterson	S. F. Patterson	S. F. Patterson
Treasurer	C. P. Austin	C. P. Austin	C. P. Austin	C. P. Austin
Executive Members	R. H. Reid	W. O. Eggleston	H. Rettinghouse	W. O. Eggleston
	W. O. Eggleston	A. E. Killam	A. E. Killam	A. E. Killam
	A. E. Killam	H. Rettinghouse	J. S. Lemond	J. S. Lemond
	R. C. Sattley	J. S. Lemond	C. W. Richey	C. W. Richey
	H. Rettinghouse	W. H. Finley	W. O. Eggleston	H. H. Eggleston
	J. S. Lemond	C. W. Richey	F. E. Schall	B. J. Sweatt

	1907-1908	1908-1909	1909-1910	1910-1911
President	R. H. Reid	J. P. Canty	H. Rettinghouse	H. Rettinghouse
1st V.-Pres.	J. P. Canty	H. Rettinghouse	J. S. Lemond	F. E. Schall
2nd V.-Pres.	H. Rettinghouse	F. E. Schall	F. E. Schall	A. E. Killam
3rd V.-Pres.	F. E. Schall	J. S. Lemond	A. E. Killam	J. N. Penwell
4th V.-Pres.	W. O Eggleston	A. E. Killam	J. N. Penwell	L. D. Hadwen
Secretary	S. F. Patterson	S. F. Patterson	C. A. Lichty	C. A. Lichty
Treasurer	C. P. Austin	C. P. Austin	J. P. Canty	J. P. Canty
Executive Members	A. E. Killam	J. N. Penwell	W. Beahan	T. J. Fullem
	J. S. Lemond	Willard Beahan	F. B. Scheetz	G. Aldrich
	C. W. Richey	F. B. Scheetz	L. D. Hadwen	P. Swenson
	T. S. Leake	W. H. Finley	T. J. Fullem	G. W. Rear
	W. H. Finley	L. D. Hadwen	G. Aldrich	W. O. Eggleston
	J. N. Penwell	T. J. Fullem	P. Swenson	W. F. Steffens

	1911-1912	1912-1913	1913-1914	1914-1915
President	F. E. Schall	A. E. Killam	J. N. Penwell	L. D. Hadwen
1st V.-Pres.	A. E. Killam	J. N. Penwell	L. D. Hadwen	G. Aldrich
2nd V.-Pres.	J. N. Penwell	L. D. Hadwen	G. Aldrich	G. W. Rear
3rd V.-Pres.	L. D. Hadwen	T. J. Fullem	G. W. Rear	C. E. Smith
4th V.-Pres.	T. J. Fullen	G. Aldrich	C. E. Smith	E. B. Ashby
Secretary	C. A. Lichty	C. A. Lichty	C. A. Lichty	C. A. Lichty
Treasurer	J. P. Canty	J. P. Canty	J. P. Canty	F. E. Weise
Executive Members	G. Aldrich	G. W. Rear	W. F. Steffens	W. F. Steffens
	P. Swenson	W. F. Steffens	E. B. Ashby	S. C. Tanner
	G. W. Rear	E. B. Ashby	S. C. Tanner	Lee Jutton
	W. F. Steffens	C. E. Smith	Lee Jutton	F. F. Strouse
	E. B. Ashby	S. C. Tanner	W. F. Strouse	C. R. Knowles
	W. O. Eggleston	Lee Jutton	C. R. Knowles	A. Ridgway

	1915-1916	1916-1917	1917-1918	1918-1919
President	G. W. Rear	C. E. Smith	S. C. Tanner	Lee Jutton
1st V.-Pres.	C. E. Smith	E. B. Ashby	Lee Jutton	F. E. Weise
2nd V.-Pres.	E. B. Ashby	S. C. Tanner	F. E. Weise	W. F. Strouse
3rd V.-Pres.	S. C. Tanner	Lee Jutton	W. F. Strouse	C. R. Knowles
4th V.-Pres.	Lee Jutton	F. E. Weise	C. R. Knowles	A. Ridgway
Sec.-Treas.	C. A. Lichty	C. A. Lichty	C. A. Lichty	C. A. Lichty
Executive Members	F. E. Weise	W. F. Strouse	A. Ridgway	J. S. Robinson
	W. F. Strouse	C. R. Knowles	J. S. Robinson	J. P. Wood
	C. R. Knowles	A. Ridgway	J. P. Wood	A. B. McVay
	A. Ridgway	J. S. Robinson	D. C. Zook	J. H. Johnston
	J. S. Robinson	J. P. Wood	A. B. McVay	E. T. Howson
	J. P. Wood	D. C. Zook	J. H. Johnston	C. W. Wright

	1919-1920	1920-1921	1921-1922	1922-1923
President	F. E. Weise	W. F. Strouse	C. R. Knowles	Arthur Ridgway
1st V.-Pres.	W. F. Strouse	C. R. Knowles	A. Ridgway	J. P. Wood
2nd V.-Pres.	C. R. Knowles	A. Ridgway	J. S. Robinson	J. S. Robinson
3rd V.-Pres.	A. Ridgway	J. S. Robinson	J. P. Wood	C. W. Wright
4th V.-Pres.	J. S. Robinson	J. P. Wood	C. W. Wright	E. T. Howson
Sec.-Treas.	C. A. Lichty	C. A. Lichty	C. A. Lichty	C. A. Lichty
Asst. Sec.			F. E. Weise	F. E. Weise
Directors	J. P. Wood	C. W. Wright	E. T. Howson	F. C. Baluss
	A. B. McVay	A. B. McVay	J. H. Johnson	Maro Johnson
	J. H. Johnston	G. A. Manthey	E. K. Barrett	O. F. Dalstrom
	E. T. Howson	E. T. Howson	F. C. Baluss	S. D. Corey
	C. W. Wright	J. H. Johnston	Maro Johnson	W. B. Hotson
	G. A. Manthey	E. K. Barrett	O. F. Dalstrom	P. N. Nelson

	1923-1924	1924-1925	1925-1926	1926-1927
President	J. S. Robinson	J. P. Wood	C. W. Wright	E. T. Howson
1st V.-Pres.	J. P. Wood	C. W. Wright	E. T. Howson	F. C. Baluss
2nd V.-Pres.	C. W. Wright	E. T. Howson	F. C. Baluss	Maro Johnson
3rd V.-Pres.	E. T. Howson	F. C. Baluss	Maro Johnson	J. S. Huntoon
4th V.-Pres.	F. C. Baluss	Maro Johnson	J. S. Huntoon	C. S. Heritage
Sec.-Treas.	C. A. Lichty	C. A. Lichty	C. A. Lichty	C. A. Lichty
Asst. Sec.	F. E. Weise	F. E. Weise	F. E. Weise	F. E. Weise
Directors	S. T. Corey	J. S. Huntoon	C. S. Heritage	A. I. Gauthier
	W. B. Hotson	A. I. Gauthier	W. B. Hotson	E. L. Sinclair
	P. N. Nelson	E. L. Sinclair	P. N. Nelson	P. F. Dalstrom
	J. S. Huntoon	C. S. Heritage	A. I. Gauthier	W. T. Krausch
	A. I. Gauthier	W. B. Hotson	E. L. Sinclair	R. C. Bardwell
	E. L. Sinclair	P. N. Nelson	O. F. Dalstrom	H. I. Benjamin

	1927-1928	1928-1929	1929-1930	1930-1934
President	F. C. Baluss	Maro Johnson	J. S. Huntoon	C. S. Heritage
1st V.-Pres.	Maro Johnson	J. S. Huntoon	C. S. Heritage	A. I. Gauthier
2nd V.-Pres.	J. S. Huntoon	C. S. Heritage	A. I. Gauthier	H. I. Benjamin
3rd V.-Pres.	C. S. Heritage	A. I. Gauthier	H. I. Benjamin	W. T. Krausch
4th V.-Pres.	A. I. Gauthier	H. I. Benjamin	W. T. Krausch	T. H. Strate
Sec.-Treas.	C. A. Lichty	C. A. Lichty	C. A. Lichty	C. A. Lichty
Asst. Sec.	F. E. Weise	F. E. Weise		
Directors	W. T. Krausch	R. C. Henderson	G. A. Rodman	E. C. Neville
	R. C. Bardwell	J. S. Ekey	W. A. Batey	H. H. Best
	H. I. Benjamin	T. H. Strate	F. W. Hillman	J. E. King
	R. C. Henderson	G. A. Rodman	E. C. Neville	A. B. Scowden
	T. H. Strate	W. A. Batey	H. H. Best	W. A. Batey
	J. S. Ekey	F. W. Hillman	J. E. King	L. C. Smith

	1934–1935	1935–1936	1936–1937	1937–1938
President	H. I. Benjamin	T. H. Strate	E. C. Neville	C. M. Burpee
1st V.-Pres.	T. H. Strate	E. C. Neville	C. M. Burpee	F. H. Masters
2nd V.-Pres.	E. C. Neville	C. M. Burpee	F. H. Masters	W. S. Lacher
3rd V.-Pres.	A. B. Scowden	F. H. Masters	C. A. J. Richards	C. A. J. Richards
4th V.-Pres.	W. R. Roof	C. A. J. Richards	W. S. Lacher	F. H. Cramer
Sec.-Treas.	C. A. Lichty	C. A. Lichty	C. A. Lichty	C. A. Lichty
Directors	C. M. Burpee	A. L. McCloy	W. R. Roof	B. R. Meyers
	W. A. Batey	R. P. Luck	T. P. Soule	G. S. Crites
	L. C. Smith	H. H. Best	F. H. Cramer	R. E. Dove
	C. A. J. Richards	W. R. Roof	B. R. Meyers	T. P. Soule
	A. L. McCloy	T. P. Soule	G. S. Crites	A. Chinn
	R. P. Luck	F. H. Cramer	R. E. Dove	L. G. Byrd

	1938–1939	1939–1940	1940–1941	1941–1942
President	Armstrong Chinn	A. E. Bechtelheimer	H. M. Church	R. E. Dove
1st V.-Pres.	F. H. Cramer	F. H. Cramer	R. E. Dove	F. H. Soothill
2nd V.-Pres.	A. E. Bechtelheimer	H. M. Church	F. A. Soothill	G. S. Crites
3rd V.-Pres.	H. M. Church	R. E. Dove	G. S. Crites	A. M. Knowles
4th V.-Pres.	R. E. Dove	F. H. Soothill	A. M. Knowles	N. D. Howard
Sec.-Treas.	C. A. Lichty	C. A. Lichty		
Secretary	....	....	F. O. Whiteman	A. G. Shaver
Treasurer	....	....	F. E. Weise	F. E. Weise
Directors	L. G. Byrd	B. R. Meyers	N. D. Howard	R. E. Caudle
	W. R. Ganser	W. Walkden	L. G. Byrd	I. A. Moore
	F. H. Soothill	A. S. Krefting	K. L. Miner	W. A. Sweet
	B. R. Meyers	A. M. Knowles	R. E. Caudle	J. L. Varker
	W. Walkden	L. G. Byrd	I. A. Moore	L. E. Peyser
	A. S. Krefting	K. L. Miner	W. A. Sweet	Martin Meyer

	1942–1943	1943–1944	1944–1945	1945–1946
President	G. S. Crites	J. L. Varker	J. L. Varker	N. D. Howard
1st V.-Pres.	R. E. Caudle	R. E. Caudle	R. E. Caudle	F. G. Campbell
2nd V.-Pres.	A. M. Knowles	N. D. Howard	N. D. Howard	J. S. Hancock
3rd V.-Pres.	N. D. Howard	F. G. Campbell	F. G. Campbell	E. H. Barnhart
4th V.-Pres.	J. L. Varker	J. S. Hancock	J. S. Hancock	W. F. Martens
Secretary	A. G. Shaver† Lorene Kindred‡ Elinor V. Heffern	Elinor V. Heffern	Elise LaChance	Elise LaChance
Treasurer	F. E. Weise	C. R. Knowles	C. R. Knowles	C. R. Knowles
Treasurer Emeritus		F. E. Weise	F. E. Weise	
Directors	M. Meyer	W. F. Martens	W. F. Martens	A. B. Chapman
	L. E. Peyser	A. L. McCloy	A. L. McCloy	W. A. Huckstep
	K. L. Miner	L. C. Winkelhaus	L. C. Winkelhaus	F. R. Spofford
	F. G. Campbell	E. H. Barnhart	E. H. Barnhart	Guy E. Martin
	J. S. Hancock	A. B. Chapman	A. B. Chapman	B. R. Meyers
	L. C. Winkelhaus	L. E. Peyser	L. E. Peyser	L. E. Peyser

†To November 1, 1942 ‡To February 1, 1943

	1946–1947	1947–1948	1948–1949	1949–1950
President	F. G. Campbell	J. S. Hancock	E. H. Barnhart	W. F. Martens
1st V.-Pres.	J. S. Hancock	E. H. Barnhart	W. F. Martens	W. A. Huckstep
2nd V.-Pres.	E. H. Barnhart	W. F. Martens	W. A. Huckstep	Guy E. Martin
3rd V.-Pres.	W. F. Martens	W. A. Huckstep	Guy E. Martin	F. R. Spofford
4th V.-Pres.	W. A. Huckstep	G. E. Martin	F. R. Spofford	Lee Mayfield
Secretary	Elise LaChance	Elise LaChance	Elise LaChance	Elise LaChance
Treasurer	C. R. Knowles	C. R. Knowles	L. C. Winkelhaus	L. C. Winkelhaus
Directors	Guy E. Martin	H. M. Harlow	Lee Mayfield	H. M. Harlow
	B. R. Meyers	H. B. Christianson	F. M. Misch	V. E. Engman
	L. E. Peyser	F. R. Spofford	W. D. Gibson	G. W. Benson
	H. M. Harlow	Lee Mayfield	H. M. Harlow	F. M. Misch
	H. B. Christianson	Franz M. Misch	V. E. Engman	L. R. Morgan
	F. R. Spofford	W. D. Gibson	G. W. Benson	J. A. Jorlett

	1950–1951	1951–1952	1952–1953	1953–1954
President	W. A. Huckstep	Guy E. Martin	F. R. Spofford	Lee Mayfield
1st V.-Pres.	Guy E. Martin	F. R. Spofford	Lee Mayfield	H. M. Harlow
2nd V.-Pres.	F. R. Spofford	Lee Mayfield	H. M. Harlow	J. A. Jorlett
3rd V.-Pres.	Lee Mayfield	H. M. Harlow	J. A. Jorlett	R. R. Gunderson
4th V.-Pres.	H. M. Harlow	J. A. Jorlett	R. R. Gunderson	W. H. Huffman
Secretary	Elise LaChance	Elise LaChance	Elise LaChance	Elise LaChance
Treasurer	L. C. Winkelhaus	L. C. Winkelhaus	L. C. Winkelhaus	L. C. Winkelhaus
Directors	F. M. Misch	M. H. Dick	W. H. Huffman	M. H. Dick
	L. R. Morgan	R. R. Gunderson	L. R. Morgan	J. F. Warrenfells
	J. A. Jorlett	J. F. Warrenfells	B. M. Stephens	G. Switzer
	M. H. Dick	W. H. Huffman	M. H. Dick	B. M. Stephens
	R. R. Gunderson	L. R. Morgan	J. F. Warrenfells	W. H. Bunge
	J. F. Warrenfells	B. M. Stephens	G. Switzer	E. R. Schlaf

	1954–1955	1955–1956	1956–1957	1957–1958
President	H. M. Harlow	J. A. Jorlett	R. R. Gunderson	W. H. Huffman
1st V.-Pres.	J. A. Jorlett	R. R. Gunderson	W. H. Huffman	M. H. Dick
2nd V.-Pres.	R. R. Gunderson	W. H. Huffman	M. H. Dick	B. M. Stephens
3rd V.-Pres.	W. H. Huffman	M. H. Dick	B. M. Stephens	H. D. Curie
4th V.-Pres.	M. H. Dick	B. M. Stephens	H. D. Curie	
Secretary	Elise LaChance	Elise LaChance	Elise LaChance	Elise LaChance
Treasurer	L. C. Winkelhaus	L. C. Winkelhaus	L. C. Winkelhaus	L. C. Winkelhaus
Directors	B. M. Stephens	J. F. Warrenfells	W. H. Bunge	G. W. Benson
	W. H. Bunge	H. D. Curie	E. R. Schlaf	J. M. Lowry
	E. R. Schlaf	J. M. Lowry	G. W. Benson	H. H. Matthews
	J. F. Warrenfells	W. H. Bunge	J. M. Lowry	T. M. VonSprecken
	H. D. Curie	E. R. Schlaf	T. M. VonSprecken	W. H. Bunge
	J. M. Lowry	G. W. Benson	H. A. Matthews	E. R. Schlaf

	1958–1959	1959–1960	1960–1961	1961–1962
President	M. H. Dick	B. M. Stephens	H. D. Curie	G. W. Benson
1st V.-Pres.	B. M. Stephens	H. D. Curie	G. W. Benson	J. M. Lowry
2nd V.-Pres.	H. D. Curie	G. W. Benson	J. M. Lowry	E. R. Schlaf
3rd V.-Pres.	G. W. Benson	J. M. Lowry	E. R. Schlaf	H. A. Matthews
Secretary	Ruth Weggeberg	Ruth Weggeberg	Ruth Weggeberg	Ruth Weggeberg
Treasurer	L. C. Winkelhaus	L. C. Winkelhaus	L. C. Winkelhaus	L. C. Winkelhaus
Directors	J. M. Lowry	W. H. Bunge	H. A. Matthews	R. C. Baker
	R. C. Baker	E. R. Schlaf	M. J. Hubbard	R. H. Miller
	W. H. Bunge	H. A. Matthews	R. C. Baker	Shirley White
	E. R. Schlaf	M. J. Hubbard	R. H. Miller	H. M. Wilson
	H. A. Matthews	R. C. Baker	Shirley White	R. D. Hellweg
	M. J. Hubbard	R. H. Miller	H. M. Wilson	F. W. Hutcheson

	1962–1963	1963–1964	1964–1965	1965–1966
President	J. M. Lowry	E. R. Schlaf	R. C. Baker	H. M. Wilson
1st V.-Pres.	E. R. Schlaf	R. C. Baker	H. M. Wilson	R. D. Hellweg
2nd V.-Pres.	H. A. Matthews	Shirley White	R. D. Hellweg	J. W. DeValle
3rd V.-Pres.	R. C. Baker	H. M. Wilson	J. W. DeValle	W. F. Armstrong
Secretary	Ruth Weggeberg	Ruth Weggeberg	Ruth Weggeberg	Ruth Weggeberg
Treasurer	L. C. Winkelhaus	E. F. Snyder	E. F. Snyder	E. F. Snyder
Directors	Shirley White	R. D. Hellweg	W. F. Armstrong	J. A. Goforth
	H. M. Wilson	F. W. Hutcheson	J. S. Ellis	E. R. Simmons
	R. D. Hellweg	W. F. Armstrong	J. A. Goforth	N. D. Bryant
	F. W. Hutcheson	J. W. DeValle	E. R. Simmons	A. R. Dahlberg
	W. F. Armstrong	J. A. Goforth	N. D. Bryant	J. S. Ellis
	J. W. DeValle	E. R. Simmons	A. R. Dahlberg	T. L. Fuller

	1966–1967	1967–1968	1968–1969	1969–1970
President	R. D. Hellweg	J. W. DeValle	W. F. Armstrong	J. A. Goforth
1st V.-Pres.	J. W. DeValle	W. F. Armstrong	J. A. Goforth	A. R. Dahlberg
2nd V.-Pres.	W. F. Armstrong	J. A. Goforth	A. R. Dahlberg	T. L. Fuller
3rd V.-Pres.	J. A. Goforth	A. R. Dahlberg	T. L. Fuller	N. D. Bryant
Secretary	Ruth Weggeberg	Ruth Weggeberg	Ruth Weggeberg	Ruth Weggeberg
Treasurer	W. H. Huffman	W. H. Huffman	W. H. Huffman	W. H. Huffman
Directors	N. D. Bryant	J. S. Ellis	N. F. Lucas	W. H. Rankin
	A. R. Dahlberg	T. L. Fuller	W. L. Short	E. E. Runde
	H. F. Lucas	R. A. Youngblood	C. E. Wachter	T. A. Reynolds
	J. S. Ellis	H. F. Lucas	A. C. Jones	J. J. Ridgeway
	T. L. Fuller	W. L. Short	W. H. Rankin	J. R. Williams
	R. A. Youngblood	C. E. Wachter	E. E. Runde	J. W. Chambers
	V. D. Raessler	A. C. Jones	T. A. Reynolds	R. E. Frame
	W. L. Short	W. H. Rankin	J. J. Ridgeway	J. C. Hobbs
	C. E. Wachter	E. E. Runde	J. R. Williams	

	1970–1971	1971–1972	1972–1973	1973–1974
President	A. R. Dahlberg	T. L. Fuller	N. D. Bryant	E. E. Runde
1st V.-Pres.	T. L. Fuller	N. D. Bryant	E. E. Runde	J. J. Ridgeway
2nd V.-Pres.	N. D. Bryant	E. E. Runde	J. J. Ridgeway	J. R. Williams
3rd V.-Pres.	E. E. Runde	J. J. Ridgeway	J. R. Williams	W. R. Rankin
Secretary	Ann Wilson	Ann Wilson	Ann Wilson	Ann Wilson
Treasurer	W. H. Huffman	W. H. Huffman	W. H. Huffman	W. H. Huffman
Directors	T. A. Reynolds	J. W. Chambers	R. K. Corbett	D. C. Gould
	J. J. Ridgeway	R. E. Frame	J. R. Iwinski	W. S. Stokely
	J. R. Williams	J. C. Hobbs	J. S. Pritchett	W. C. Sturm
	J. W. Chambers	R. K. Corbett	D. C. Gould	J. W. Davidson
	R. E. Frame	J. R. Iwinski	W. S. Stokely	C. A. Hughes
	J. C. Hobbs	J. S. Pritchett	W. C. Sturm	W. R. Hyma
	R. K. Corbett	D. C. Gould	J. W. Davidson	O. C. Denz
	J. R. Iwinsky	W. S. Stokely	C. A. Hughes	R. C. McMaster
	J. S. Pritchett	W. C. Sturm	W. R. Hyma	W. E. Brakensiek

	1974–1975	1975–1976	1976–1977	1977–1978
President	J. J. Ridgeway	J. R. Williams	W. H. Rankin	J. R. Iwinski
1st V.-Pres.	J. R. Williams	W. H. Rankin	J. R. Iwinski	W. C. Sturm
2nd V.-Pres.	W. H. Rankin	J. C. Hobbs	W. C. Sturm	D. C. Gould
3rd V.-Pres.	J. C. Hobbs	J. R. Iwinski	D. C. Gould	J. W. Chambers
Secretary	Ann Wilson	Ann Wilson	Ann Wilson	Ann Wilson
Treasurer	W. H. Huffman	W. H. Huffman	W. H. Huffman	W. H. Huffman
Directors	J. W. Davidson	W. E. Brakensiek	J. W. Chambers	W. J. Gunkle
	C. A. Hughes	O. C. Denz	M. Noyszewski	W. E. Halley
	W. R. Hyma	R. C. McMaster	W. J. Gunkle	K. L. Wammell
	W. E. Brakensiek	F. R. Lindsay	W. E. Halley	J. Budzileni
	O. C. Denz	M. Noyszewski	K. L. Wammel	B. J. King
	R. C. McMaster	W. C. Sturm	J. Budzileni	J. G. Robertson
	F. B. Lindsay, Jr.	W. J. Gunkle	B. J. King	O. C. Denz
	M. Noyszewski	W. E. Halley	J. G. Robertson	E. C. Patterson
	Jim Payne	K. L. Wammel		W. S. Stokely

	1978–1979	1979–1980	1980–1981	1981–1982
President	W. C. Sturm	D. C. Gould	J. W. Chambers	W. R. Hyma
Sr. V.-Pres.	D. C. Gould	J. W. Chambers	R. C. McMaster	O. C. Denz
Jr. V.-Pres.	J. W. Chambers	R. C. McMaster	W. R. Hyma	J. Budzileni
Jr. V.-Pres.	R. C. McMaster	W. R. Hyma	O. C. Denz	J. M. Williams
Secretary	Ann Wilson	Ann Wilson	Ann Wilson	Pat Weissmann
Treasurer	W. F. Armstrong	W. F. Armstrong	W. F. Armstrong	W. C. Sturm
Directors	J. Budzileni	O. C. Denz	J. W. Davidson	D. A. Bessey
	B. J. King	W. J. Gunkle	C. M. Russell	J. N. Michel
	J. G. Robertson	W. S. Stokely	J. M. Williams	P. H. Saletnik
	O. C. Denz	L. D. Green	D. A. Bessey	O. D. Anthony
	E. C. Patterson	C. M. Russell	J. N. Michel	J. T. Kapp
	W. S. Stokely	J. M. Williams	P. H. Saletnik	D. J. Lewis
	L. D. Green	D. A. Bessey	O. D. Anthony	J. W. Davidson
	C. M. Russell	J. N. Michel	J. T. Kapp	H. J. Laga
	J. M. Williams	P. H. Saletnik	D. J. Lewis	A. S. Uppal

	1982–1983	1983-1984	1984-1985	1985-1986
President	O. C. Denz	J. Budzileni	J.M. Williams	D. A. Bessey
Sr. Vice President	J. Budzileni	J.M. Williams	D.A. Bessey	J. T. Kapp
Jr. Vice President	J. M. Williams	D.A. Bessey	J.T. Kapp	D. J. Lewis
Jr. Vice President	D. A. Bessey	J.T. Kapp	D.J. Lewis	R. A. Tallent
Secretary	P. A. Weissmann	P.A. Weissmann	P.A. Weissmann	P. A. Weissmann
Treasurer	P. H. Saletnik	P.H. Saletnik	P.H. Saletnik	J. M. Williams
Directors	O. D. Anthony	J.W. Davidson	T.E. Kuhn	B. T. Burns
	J. T. Kapp	D.J. Lewis	D.R. Ladner	J. J. Horney
	D. J. Lewis	T.E. Kuhn	R.A. Tallent	W. J. Semioli
	J. W. Davidson	D.R. Ladner	B.T. Burns	R. E. Fronczak
	H. J. Laga	R.A. Tallent	J.J. Horney	W. P. Cunningham
	A. S. Uppal	B.T. Burns	W.J. Semioli	J. H. Smith
	T. E. Kuhn	J.J. Horney	D.W. Brookings	E. Bond
	D. R. Ladner	W.J. Semioli	W.P. Cunningham	D. L. Steele
	R. A. Tallent		J.H. Smith	M. C. Walbrun

	1986-1987	1987-1988	1988-1989	1989-1990
President	J. T. Kapp	D. J. Lewis	R. A. Tallent	B. T. Burns
Sr. Vice President	D. J. Lewis	R. A. Tallent	B. T. Burns	J. J. Horney
Jr. Vice President	R. A. Tallent	B. T. Burns	J. J. Horney	M. C. Walbrun
Jr. Vice President	B. T. Burns	J. J. Horney	M. C. Walbrun	P. H. Saletnik
Secretary	P. A. Weissmann	P. A. Weissmann	P. A. Weissmann	P. A. Weissmann
Treasurer	J. M. Williams	J. M. Williams	J. M. Williams	J. M. Williams
Directors	W. H. Nelson	M. C. Walbrun	C. E. Thompson	W. H. Nelson
	J. H. Smith	S. Lipkus	H. L. Davidson	T. J. Parker
	J. J. Horney	D. L. Steele	J. A. VanHuis	R. C. Karsten
	M. C. Walbrun	C. E. Thompson	W. H. Nelson	R. C. Carter
	E. Bond	H. L. Davidson	T. J. Parker	T. V. Dunn
	D. L. Steele	J. A. VanHuis	R. C. Karsten	M. L. Bradley
	C. E. Thompson	W. H. Nelson	S. Lipkus	D. G. DeBerg
	H. L. Davidson	T. J. Parker	T. V. Dunn	D. F. Sorgenfrei
	J. A. VanHuis	R. C. Karsten	M. L. Bradley	J. A. Lileikis

	1990-1991
President	J. J. Horney
Sr. Vice President	M. C. Walbrun
Jr. Vice President	P. H. Saletnik
Jr. Vice President	W. H. Nelson
Secretary	P. A. Weissmann
Treasurer	J. M. Williams
Directors	R. C. Carter
	T. V. Dunn
	M. L. Bradley
	D. G. DeBerg
	D. F. Sorgenfrei
	J. A. Lileikis
	D. L. McCammon
	J. T. Creighton
	J. G. Bradley

CONSTITUTION

(Revised September 18, 1990)

ARTICLE I

NAME

Section 1. This Association shall be known as the American Railway Bridge and Building Association.

ARTICLE II

OBJECT

Section 1. The object of this Association shall be the advancement of knowledge pertaining to the design, construction and maintenance of railway structures and fixed facilities by investigation, reports and discussions.

Section 2. The Association shall neither endorse nor recommend any particular devices, trademarks or materials, nor will it be responsible for any opinions expressed in papers, reports or discussion unless the same have received the endorsement of the Association in regular session.

ARTICLE III

MEMBERSHIP

Section 1. The membership of this Association shall be divided into five classes: Members, Life members, Associate members, Honorary members and Junior members.

Section 2. A member shall be a person in the railway industry (except representatives of manufacturers and/or suppliers of equipment, material or labor services, or individuals who are subject to collective bargaining) engaged in engineering, construction and maintenance of railway structures and fixed facilities; a person in the employ of a public regulatory body; a professor of engineering or architecture; a technical editor; a materials expert; a consulting engineer, or an engineer employed by a consulting engineering firm, engaged in the engineering, construction and maintenance of railway-related facilities; an engineer employed by a technical service or research and development organization; or an officer or engineer of an engineering or scientific society or association whose aims and objectives are compatible with the aims and objectives of this Association. Any person desirous of becoming a member shall make application upon the form prescribed by the Executive Committee, setting forth the applicant's name, address and practical experience. The applicant shall be recommended by at least one member of the Association to whom they are personally known. Applicants may be voted into membership at any regular executive meeting or by letter ballot of the Executive Committee, a majority vote being necessary in either instance.

Section 3. To be eligible for a life membership, an individual must have belonged to the Association for at least 15 years and in general must have retired from active employment due to age or physical disability. A life member shall have all the privileges of previous membership, except the holding of office, and shall not be required to pay annual dues. The transfer from membership to life membership shall be made in the same manner as the election of members, as prescribed in Section 2 of this Article.

Section 4. Associate members shall be responsible persons who are not eligible as members, whose pursuits or attainments qualify them to cooperate with members in the study and development of improved practices in the construction and maintenance of railway structures and fixed facilities. They shall have all the rights of members except of voting and holding office. They shall be elected in the manner prescribed for members, in Section 2 of this Article, except that they shall be recommended by either a member or an associate member of the Association to whom they are personally known.

Section 5. Honorary members shall be chosen from persons who have attained acknowledged eminence in some branch of engineering or railway service. Their number shall be limited to ten. Honorary members shall be proposed by not less than six active members and shall be elected by the majority vote of the members present at a regular meeting. They shall have all the rights of members except that of holding office and shall be exempt from the payment of dues.

Section 6. Any person in the Association membership whose conduct in any way diminishes the professionalism or prestige of the Association, or who shall refuse to comply with the rules of this Association, shall forfeit membership in the Association on a two-thirds vote of the Executive Committee.

Section 7. Membership shall continue until written resignation is received by the secretary, unless member has been previously expelled, or dropped for non-payment of dues in accordance with Section 1 of Article VII.

Section 8. Only members shall hold office in this Association, and only members and qualified life members shall be entitled to vote in the election of officers.

Section 9. Junior members shall be persons engaged in academic study toward a career in those areas described in Section 2 of this Article, but not currently employed in those areas. They shall have all the rights of members except of voting and holding office. They shall be elected in the manner prescribed for members in Section 2 of this Article, except that they need not be recommended by a member of the Association. The term of junior membership shall be limited to five years.

ARTICLE IV

OFFICERS

Section 1. The officers of the Association shall be a president, a senior vice president, two junior vice presidents, a treasurer and nine directors, who, with the most recent past president, shall constitute the Executive Committee.

Section 2. The past presidents of this Association, previous to the most recent past president, who continue to be members shall be privileged to attend all meetings of the Executive Committee, of which meetings they shall receive due notice, and be permitted to discuss all questions and to aid said committee by their advice and counsel; but said past presidents shall not have a right to vote, unless called upon to fill a quorum.

Section 3. Vacancies in any office shall be filled for the unexpired term by the Executive Committee without delay.

ARTICLE V

EXECUTIVE COMMITTEE

Section 1. The Executive Committee shall manage the affairs of the Association and shall have full power to control and regulate all matters not otherwise provided for in the constitution and by-laws and shall exercise general supervision over the financial interests of the Association, and make all necessary purchases and contracts required to conduct the general business of the Association, but shall not have the power to render the Association liable for any debt beyond the amount then in the treasury plus accounts receivable and not subject to other prior liabilities. All appropriations for special purposes must be acted upon at a regular meeting of the Association.

Section 2. Meetings of the Executive Committee may be called by a majority of the members of the committee, providing ten days' notice is given to the executive committee by mail.

Section 3. Five members of the Executive Committee, one of which shall be either the president or a vice president, shall constitute a quorum for the transaction of business.

ARTICLE VI

ELECTION OF OFFICERS AND SECRETARY AND TENURE OF OFFICE

Section 1. Except as otherwise provided, the officers shall be elected at the regular annual meeting of the Association and the election shall not be postponed except by a two-thirds vote of the members present at said annual meeting. The election shall be by vote, a majority of the votes cast being required for election. Any member of the Association not in arrears for dues shall be eligible for office, but the president shall not be eligible for re-election.

Section 2. The president, two junior vice presidents, and treasurer shall hold office for one year and the directors for three years; three directors being elected each year. The senior vice president shall hold office for one year and ascend to the office of president at the expiration of such service. All officers shall retain their office until their successors are elected and installed. A director elected for a three-year term shall not be eligible to serve two consecutive terms.

Section 3. The term of office of the treasurer may be terminated at any time by two-thirds vote of Executive Committee. The compensation of the treasurer shall be fixed by a majority vote of the Executive Committee.

Section 4. The secretary shall be appointed by a majority vote of the Executive Committee and the term shall terminate with the appointment of successor. The Executive Committee shall have the power, by two-thirds vote, to remove the secretary and appoint a successor at any time. The salary of the secretary shall be decided by a majority vote of the Executive Committee.

Section 5. The secretary and the treasurer shall be required to give bond in an amount to be fixed by the Executive Committee.

ARTICLE VII

MEMBERSHIP FEE AND DUES

Section 1. Every member, upon joining this Association, shall pay to the secretary an entrance fee and dues as prescribed by the executive committee. No member in arrears for annual dues shall be entitled to vote at any election and any member more than one year in arrears may be stricken from the list of members at the discretion of the Executive Committee.

Section 2. A person stricken from the list of members because of non-payment of dues upon written application may be reinstated as a member in the former class of membership without loss of privileges, either upon payment of all back dues (which must accompany applications) or at the discretion of the Executive Committee voting in the manner prescribed in Section 2 of Article III.

ARTICLE VIII

LOCAL SECTIONS

Section 1. Upon the application of ten or more members of the Association residing in the same geographical district, or having offices therein, the Executive Committee shall organize a local section for that district, to which all members in that district shall be eligible. Such local section shall admit to active membership only members in good standing. It shall hold not less than two meetings each year, and shall be governed by such constitution and by-laws not inconsistent with the constitution of this Association as the section membership may adopt and the Executive Committee approve.

Section 2. The parent Association shall not be put under any obligation, either financial or in the matter of policy or opinion, by any local section.

ARTICLE IX

AMENDMENTS

Section 1. This constitution may be amended at any regular meeting by a two-thirds vote of the members present, provided that notice of the proposed amendment or amendments has been sent to the members at least 30 days previous to said regular meeting.

By-Laws

(Revised December 2, 1990)

Time of Meeting

1. The regular meeting of this Association shall convene annually during the month of September, the exact date to be fixed by the Executive Committee.

2. It shall be within the power of the Executive Committee to change the time of the meeting if it becomes apparent that it is for the best interests of the Association.

Place of Meeting

3. The place of holding the annual meeting shall be determined by the Executive Committee not less than twelve months prior to the date of the annual meeting.

Quorum

4. At the regular meeting of the Association, 15 or more members shall constitute a quorum.

Dues

5. The annual dues for the fiscal year ending August 31, and payable in advance, shall be as follows:

Members, $20.00; Associate Members, $20.00; Junior Members, $20.00

Duties of Officers

6. The president shall have general supervision over the affairs of the Association. He shall preside at all meetings of the Association and of the Executive Committee; shall appoint all committees not otherwise provided for, and shall be ex-officio member of all committees. The president shall render a detailed report at least three times during the year to the members of the Executive Committee, showing the financial condition of the Association and its activities.

At the annual meeting the president shall present a report containing a statement of the general conditions of the Association.

7. The vice presidents, in order of seniority, shall preside at meetings in the absence of the president and discharge the duties of the president in case of a vacancy in his office. The senior vice president shall have the senior position of vice presidents.

8. The secretary shall keep a correct record of the proceedings of all meetings of this Association, and of all accounts, between this Association and its members, collect all moneys due the Association, and deposit the same in the name of the Association. The secretary shall pay all bills when properly certified and approved by the president or the treasurer, and make such reports as may be called for by the Executive Committee. The secretary shall sign all contracts or other written obligations of the Association which have been approved by the Executive Committee. The secretary shall also perform such other duties as the Association may required.

9. The treasurer shall have charge of the funds, check all deposits as made by the secretary, and invest all funds not needed for current expenses. The treasurer shall report at each annual meeting on the condition of the finances.

Nominating Committee

10. After each annual meeting the president shall appoint a committee consisting of five members. The most immediate past president shall act as chairperson. No other officers of the Association shall be appointed to this committee. This committee shall prepare a list of names of nominees for officers to be voted on at the next annual meeting in accordance with Article VI of the Constitution, said list to be read at the business session of said meeting. Nothing in this section shall be construed to prevent any member making further nominations provided that such nominations are received by the president in writing not less than thirty (30) days in advance of the first day of the annual meeting. Such nominations should be addressed to the president of the Association at its headquarters office.

Auditing Committee

11. Prior to each annual meeting the president shall appoint a committee of three members, not officers of the Association, whose duty it shall be to examine the accounts and vouchers of the secretary and the treasurer and certify as to the correctness of their accounts.

Orders of Business

12. Call to order by president.
    Opening prayer or invocation.
    President's address
    Reports of standing committees and presentation of papers
    Election of officers
    Business session
        Report of secretary
        Report of treasurer
        Report of auditing committee
        Report of necrology committee
        Unfinished business
        New business
    Installation of officers
    Adjournment

Decisions

13. The votes of a majority of the members present shall decide any questions, motion or resolution which shall be brought before the Association, unless otherwise provided. Unless specifically provided herein otherwise, all discussions shall be governed by Robert's Rules of Order.

Amendments

14. The By-Laws can be amended by a two-thirds vote of those present at any regularly called Executive Committee Meeting.

YOUR AD
COULD BE INCLUDED
IN THIS SECTION!

For more information contact:

American Railway
Bridge & Building Association
18154 Harwood Avenue
Homewood, Illinois 60430
Telephone: 708-799-4650
FAX: 708-799-4703

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President

Jack MacGregor
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2649 South 142nd street
P.O. Box 335
Bonner Springs, Kansas 66012

ACTIVE MEMBERS

	Joined
Adams D A, Gen B&B Supv, UP RR, 2333 Walnutwood, Baton Rouge, LA 70816	09-26-84
Allen J P, Engr Strs, NS Corp, 99 Spring St, Atlanta, GA 30303	09-20-87
Anderson B R, Corp Qlty Cncl, Conrail, 2605 Interstate Dr, Harrisburg, PA 17110	10-04-82
Anderzunas P P, Asst Div Engr, Conrail, 211 Knotty Oak Dr, Mt Laurel, NJ 08054	05-08-84
Anthony O D, Chf Engr, B&A RR, North Maine Junct Pk,RR 2, Bangor, ME 04401	10-05-71
Armenta C G, Supv Strs, AT&SF RY, 12969 Road 37, Madera, CA 93637	10-07-82
Bagwell M W, Chf Engr, Mississippi Export RR, PO Box 743, Moss Point, MS 39563	03-16-88
Bailey J , Supv B&B Dept, NIRC/METRA, 14736 S Major, Oak Forest, IL 60452	08-31-77
Baker R C, Mgr Wrk Equip, EJ&E RY, PO Box 899, Gary, IN 46401	09-14-80
Barrett J E, Exec VP, Bowman, Barrett & Assocs, Inc., 233 N Michigan, Chicago, IL 60601	12-09-71
Barrett P L, Engr Const & Mtce, AT&SF RY, 7412 Jefferson St NE, Albuquerque, NM 87109	02-17-82
Barrios R , Strl Engr, Modern Industries, Inc, PO Box 23620, Louisville, KY 40223	01-09-90
Bartholomew D E, Sr Proj Mgr RR Facilities, Sverdrup Corp, 1200--112th Ave NE POB 369, Bellevue, WA 98009	09-15-86
Bateman J D, B&B Supv, UP RR, 8831 Silent Stream, San Antonio, TX 78250	12-03-82
Battle, Jr E A, Sr Engr Shops & Yards, Metro North Commuter RR, 347 Madison Ave, 11th Flr, New York City, NY 10017	09-21-87
Beattie G W, Asst Supt Mtce, AT&SF RY, PO Box 386, La Junta, CO 81050-0386	11-05-82
Beebe L C, Mgr Sfty Srvcs, UP RR, 1416 Dodge St, Rm 800, Omaha, NE 68179	12-04-85
Begnaud R A, Asst Engr/Br Dsgn, Amtrak, 2961 Hale St, Philadelphia, PA 19149	05-08-84
Beirne J M, Mgr Trk Insp, NS Corp, 8 N Jefferson St-Box 52, Roanoke, VA 24042	08-20-76
Belkaloul E , Sr Bridge Engr, Transport Canada, 344 Slater St, Ottawa,ONT,Canada,K1A 0N5	09-16-90
Bender S , Supt Of Mtce, Pittsburgh & Conneaut Dock Co, PO Box 90, Conneaut, OH 44030	07-18-90
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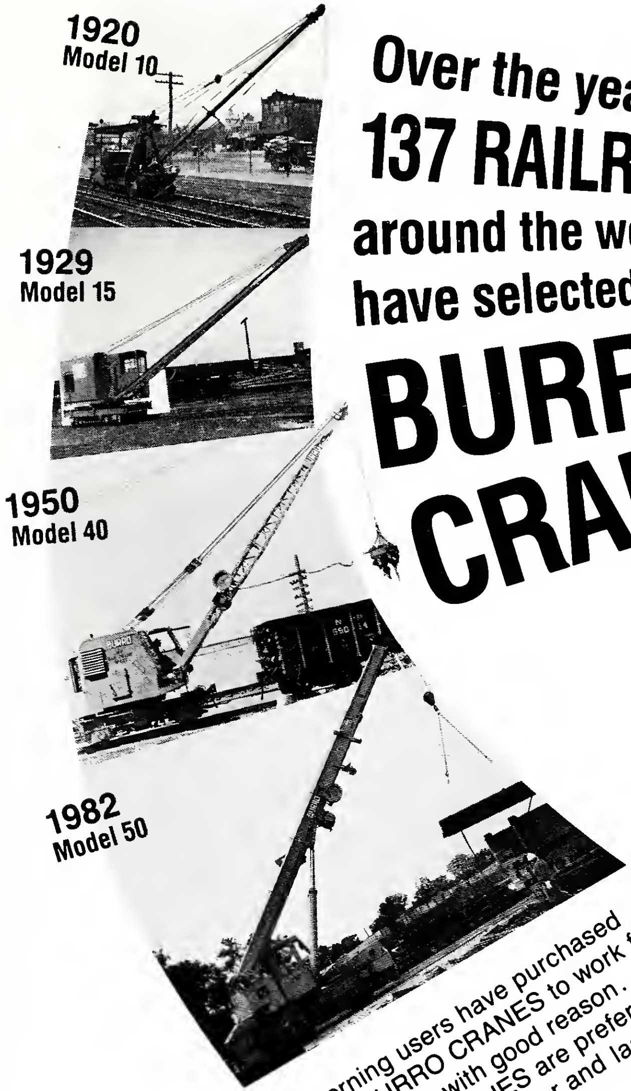

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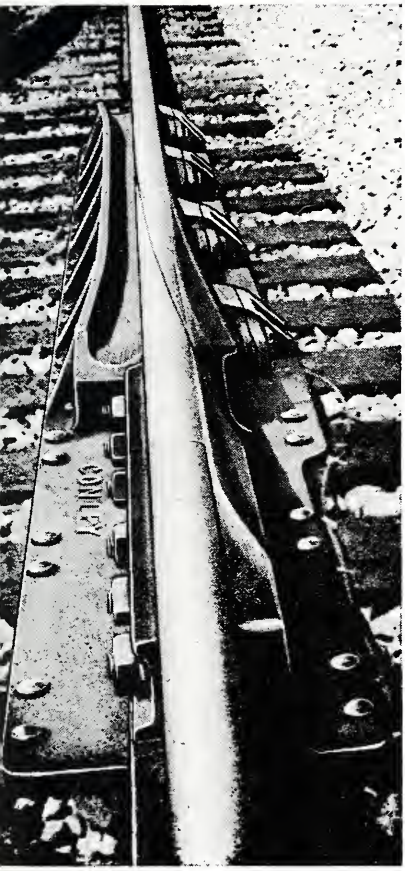

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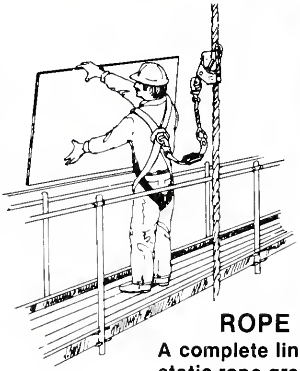

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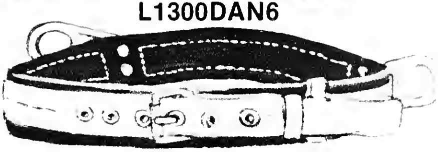

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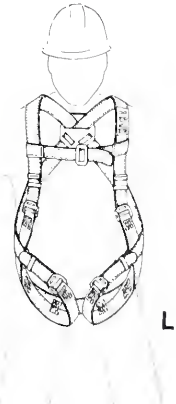

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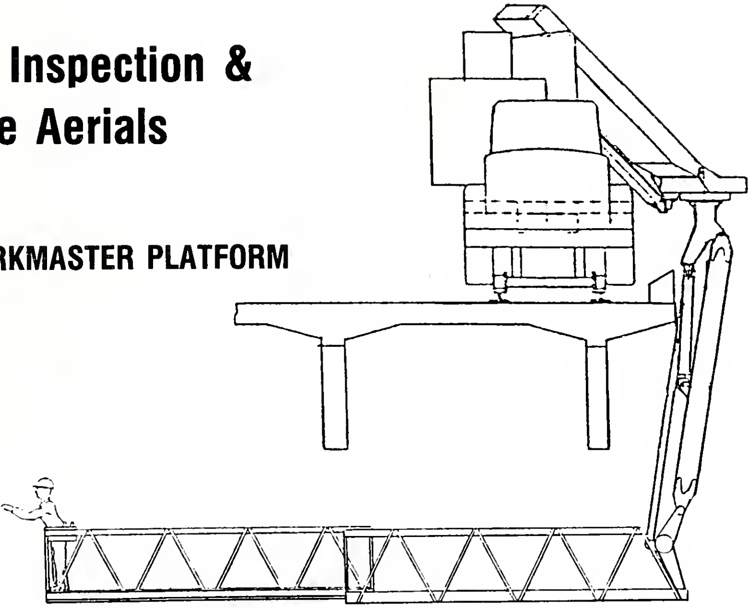

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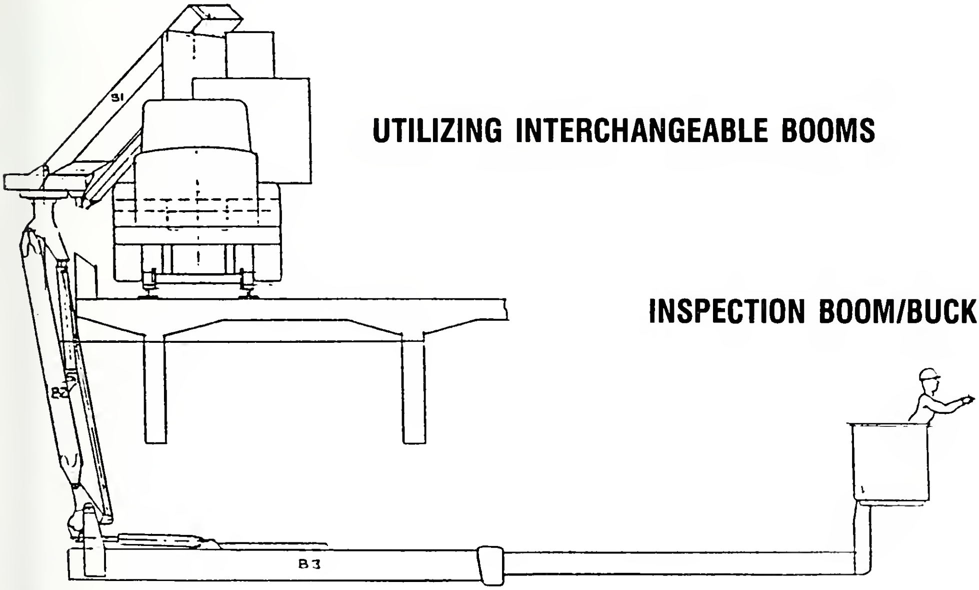

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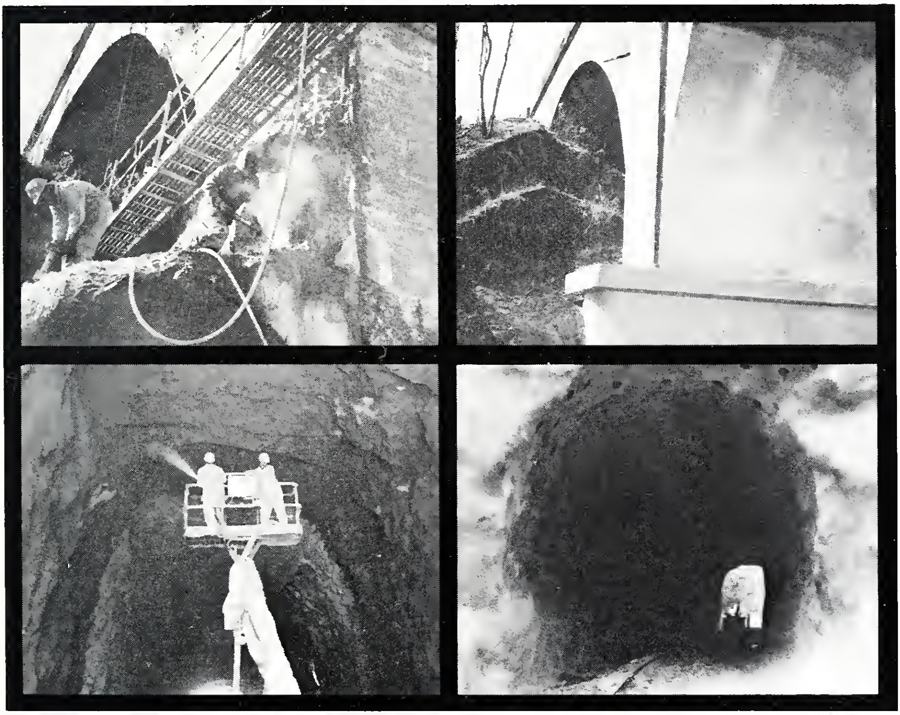

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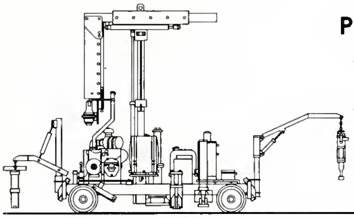

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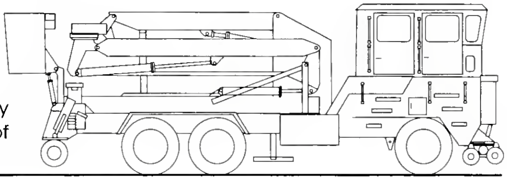

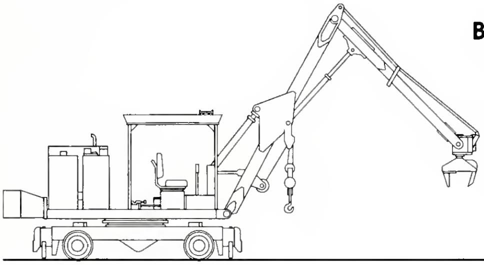

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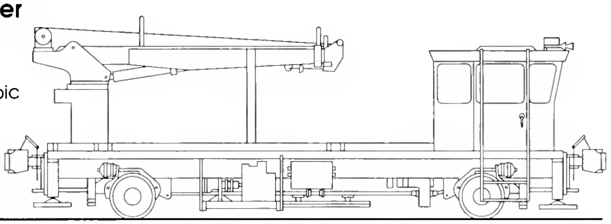

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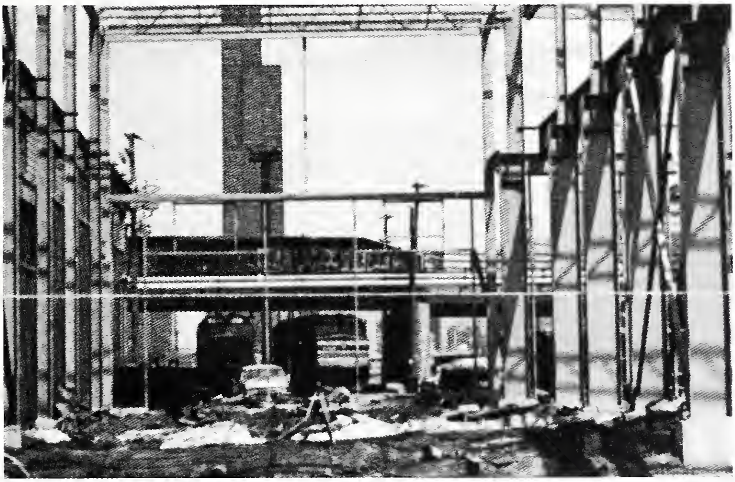

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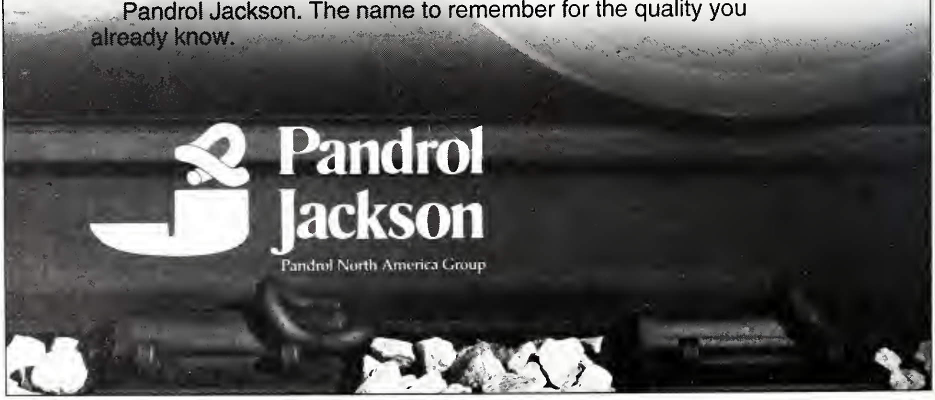

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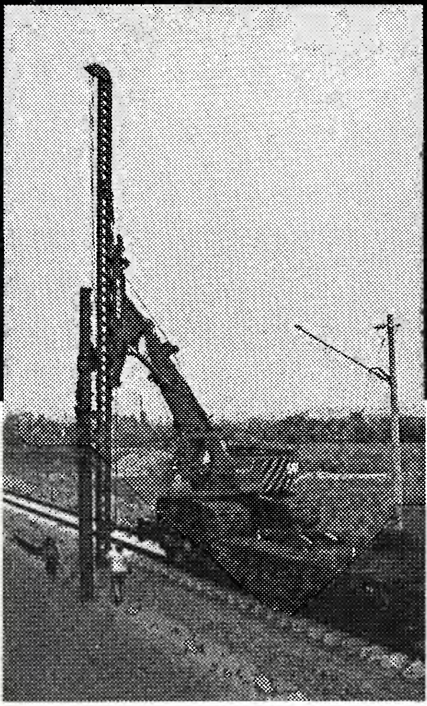

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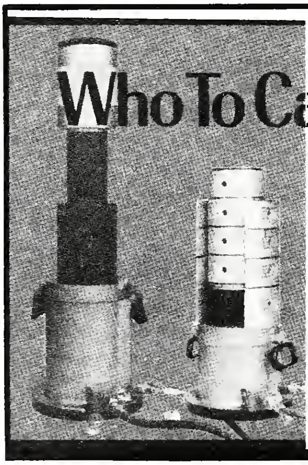

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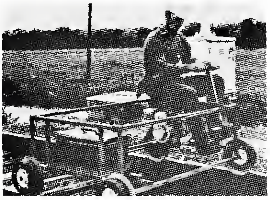

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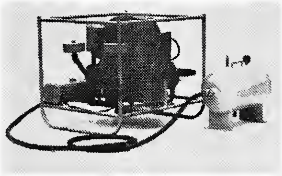

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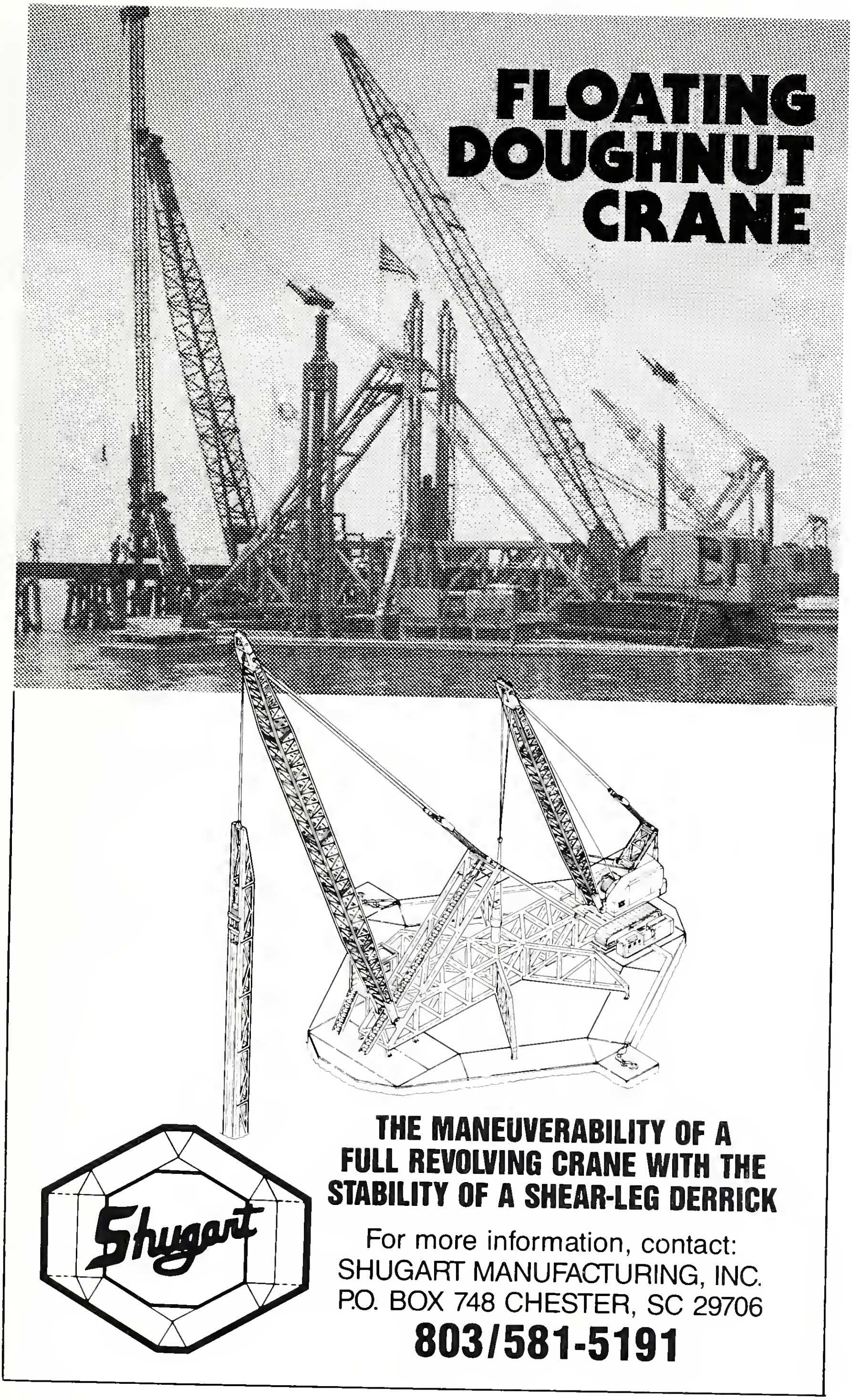

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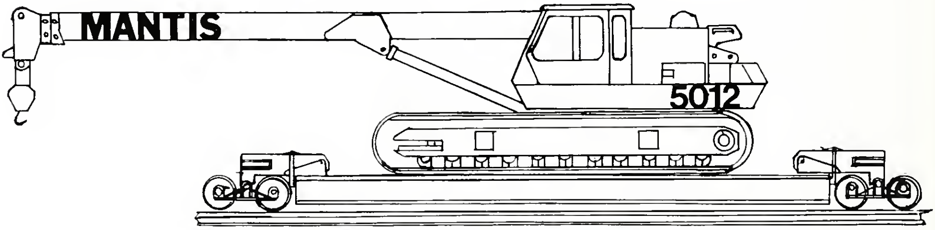

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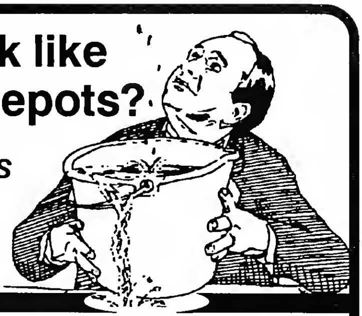

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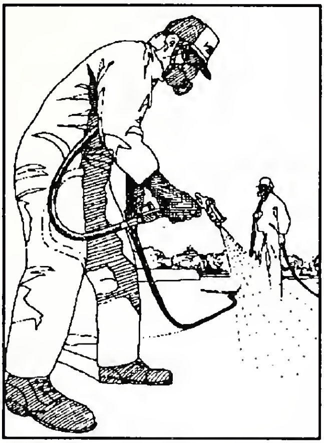

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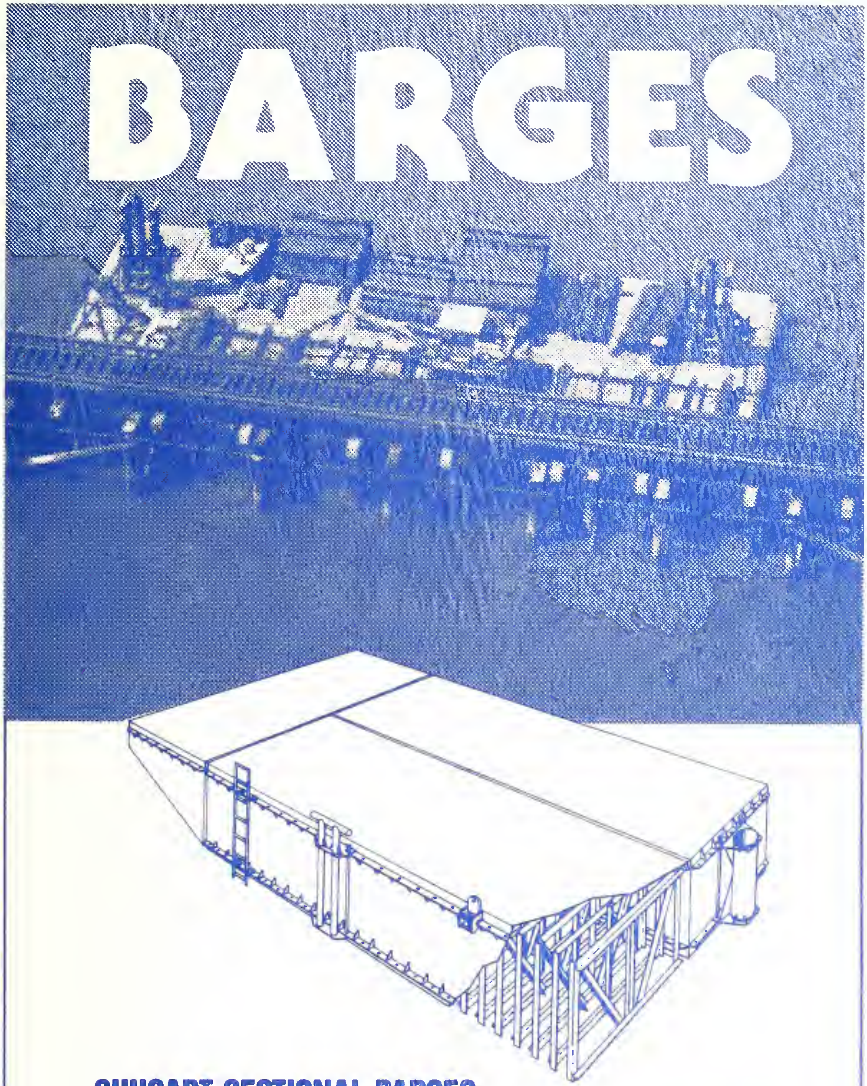

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